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ABSTRACT

The Connecticut Assessment of Educational Progress is a continuing program designed to measure objectively the adequacy and efficacy of the educational programs offered by the public schools. In 1979-80, students in grades 4, 8, and 11 were tested in science. Three goals were selected: (1) know the fundamental facts and principles of science; (2) apply the fundamental principles of science; and (3) understand and apply the processes of science. Grade 4 students answered correctly 69 percent of the items for goal 1; 52 percent of the items for goal 2; and 68.7 percent of the items for goal 3. Grade 8 students answered correctly 62.5 percent of the items for goal 1; 56.9 percent of the items for goal 2; and 67.4 percent of the items for goal 3. Grade 11 students answered correctly 55.5 percent of the items for goal 1; 49.4 percent of the items for goal 2; and 64.4 percent of the items for goal 3. Results are also reported comparing Connecticut with the nation and the northeast region, comparing the 1979-80 results with 1974-75 results; and comparing total test achievement of selected groups of Connecticut students. The results from a student attitude questionnaire are also reported. (Author/BW)

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Connecticut Assessment of Educational Progress

SCIENCE

1979-80

SUMMARY AND INTERPRETATIONS REPORT

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Connecticut Assessment of Educational Progress
Science
1979-80

SUMMARY AND INTERPRETATIONS REPORT

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Connecticut State Board of Education
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November, 1980

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STATE OF CONNECTICUT

STATE BOARD OF EDUCATION

November, 1980

Science and technology are playing an increasingly important role in the growth of our nation. The ability of our country to compete effectively and efficiently depends not only upon highly skilled scientists, engineers and technicians, but upon citizens who are knowledgeable in science and technology.

Education and the schools have an important responsibility in imparting scientific knowledge, skills and applications to students. Parents, teachers and school administrators must motivate students to achieve their full individual potential and to contribute as responsible citizens in an increasingly technical society.

There is, however, a growing body of evidence indicating that, nationally, student proficiencies in the sciences have eroded over the past two decades. As such, it is important to know what the areas of weakness are. In this way, problems may be identified and appropriate steps taken to address emerging deficiences. The Connecticut Assessment of Educational Progress in Science is an important vehicle to assist state education officials in developing policies and programs to meet identified needs in science education in Connecticut.

The Connecticut Assessment of Educational Progress annually tests a sample of Connecticut students in grades 4, 8 and 11 in one or more subject areas. Approximately 7,500 students--2,500 at each grade level--were randomly selected from 265 Connecticut public schools in 127 school districts to participate in the science assessment. At the same time, over 14,000 students from 33 school districts and the 17 vocational-technical schools also volunteered to participate in this assessment for their own purposes.

The Connecticut Assessment of Educational Progress in Science was designed to survey the science knowledge, skills, and attitudes of Connecticut students. The assessment instruments were administered to students in grades 4, 8 and 11, whether or not they were taking science, during school year 1979-80.

This report describes the results of the second statewide assessment of the science performance and attitudes of Connecticut students. It compares this performance with the Nation, the Northeast, and various sizes of communities and regions within the State. The report also compares science performance on the 1979-80 assessment with the earlier Connecticut Assessment in Science performed in 1974-75.

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Connecticut students scored higher than their national counterparts in terms of the average percentage of items answered correctly at both the fourth- and eighth-grade levels. Eleventh-grade Connecticut students scored slightly below the nation. However, when comparisons are made with the 1974-75 Connecticut Science Assessment, Connecticut students' scores declined at all three grade levels. Although these results tend to parallel a national decline on similar National Assessment of Educational Progress items, the report reveals continuing and serious problems in specific scientific areas.

The results and recommendations contained in this report should assist the state and local school districts in planning for curriculum improvement. At the state level, these results will be used to monitor our progress towards meeting the State Board Objectives for Public Education and to develop programs of technical assistance to local school districts.

The assessment was conducted by National Evaluation Systems, Inc. for the Connecticut State Department of Education. It involved the cooperation of many students, teachers and administrators throughout the state. Their time, effort and attention to this project are greatly appreciated.

Sincerely,

Mark R. Shedd
Commissioner of Education

MRS:ks

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CHAPTER I

INTRODUCTION

Overview

PURPOSE. The 1979-80 school year marked the eighth consecutive year in which the State of Connecticut conducted the Connecticut Assessment of Educational Progress (CAEP). This assessment program, as mandated by the Connecticut General Assembly, is a continuing program designed to measure objectively the adequacy and efficacy of the educational programs offered by the public schools. This year, students in Grades 4, 8, and 11 were tested in science. The goals of the 1979-80 assessment were:

- to provide useful and accurate information on the quality of education in Connecticut to educators, school administrators, students, parents, and the public at large
- to collect data for comparing student growth in science to previous assessment information in order to gauge statewide progress and to determine future educational policy
- to collect information permitting the comparison of the present achievement of Connecticut students with the achievement of students nationally
- to enable school districts to collect information and to implement their own assessment practices by making statewide assessment procedures and tests available.

BACKGROUND. The CAEP program is modeled after the National Assessment of Educational Progress (NAEP) in its basic goals, design, and implementation. NAEP was founded in 1964 and began testing in 1969. The goal of the National Assessment program is to provide continuous, systematic reporting of the knowledge, skills, understanding, and attitudes of American children and young adults based on annual national surveys. Each year one or more subject areas are tested. The NAEP testing program generates data on national achievement levels against which statewide data can be compared.

Since 1971, Connecticut statewide assessments have been conducted in reading, career guidance, science, mathematics, career education, and citizenship/social studies. Because a previous science assessment had been conducted in 1974-75 this year's science assessment was of particular importance. Not only are national comparisons possible, as in all CAEP assessments, but additional state comparisons utilizing the results from the 1974-75 assessment can be made.

This year, the assessment in science was conducted by National Evaluation Systems, Inc. (NES) of Amherst, Massachusetts under contract to the Connecticut State Department of Education (CSDE). Staff of both NES and CSDE worked jointly on all aspects of the assessment program. Additional support was provided by a Science Advisory Committee which consisted of educators from across the state involved in many aspects and levels of science education. Major program components included the development of the test instruments, administration of the tests to a sample of students across the state in Grades 4, 8, and 11, analysis and interpretation of the data obtained in the statewide testing, and dissemination of the results of the assessment. In conjunction with the statewide assessment, CSDE provided local districts an opportunity to use the state's custom-designed materials to assess their own students through the Local Assessment Option (see page 10).

Measurement Instruments

The goal of the test development phase of the assessment was to produce:

1) customized achievement tests comprised of exercises matched to learning objectives in science, and

2) student questionnaires with which to collect information on individual student and attitudinal variables.

THE OBJECTIVES. The first activity of the Science Advisory Committee, in cooperation with State Department of Education and National Evaluation Systems staff, was the development of appropriate testing instruments with which to measure student achievement in science. In order to accomplish this task, it was necessary to identify and select goal areas and objectives to be measured by the assessment instruments. Drawing entirely from NAEP materials, three goal areas were identified which were considered of high priority and appropriate to all three target grade levels. The goal areas were then further subdivided to yield seven objectives. A list of these goals and objectives may be found in Table 1. In this table, goals are designated by Roman numerals, while objectives are designated by Arabic numerals.

TABLE 1

GOALS AND OBJECTIVES

I. Know the fundamental facts and principles of science.

1. Biological science
2. Physical science
3. Earth science

II. 4. Apply the fundamental principles of science.

III. Understand and apply the processes of science.

5. Analysis of data
   Tabular data
   Graphic representation (includes models)

6. Observation and inference
7. Identifying and controlling variables

THE TESTS. After the objectives had been defined, test items were selected to measure the skills specified by the objectives. In addition, each of the three tests were developed according to the following guidelines.

- The objectives assessed should focus on basic science principles and concepts.
- In no way should the objectives to be tested attempt to represent all of the skills and concepts being taught at a particular grade level.
- Approximately 50% of the items on each test should consist of items used in the 1974-75 CAEP science assessment.

The item pool consisted of items drawn from NAEP materials and included items previously administered in the 1974-75 CAEP assessment. Each item in the pool was reviewed and discussed. With the exception of item 45 on the test for Grade 4, all items were multiple-choice in format. (Item 45 was a fill-in item.) After careful consideration, 45, 65, and 75 items were chosen to be administered at grade levels 4, 8, and 11, respectively.

In order to make grade-level comparisons, some items were selected to appear on more than one test form. Test instruments for Grades 4 and 8 included ten identical items; fifteen identical items were selected to appear on the tests for both Grades 8 and 11. One item was selected for administration at all three grade levels. The number of test items unique to a test form was, therefore, 35, 41, and 60 for Grades 4, 8, and 11, respectively.

As stated above, some of the items which appeared on the 1974-75 assessment instruments were selected for inclusion on the 1979-80 test forms. Inclusion of items from the previous CAEP assessment makes year-to-year item comparisons possible. Of the 45 items selected for the 1979-80 Grade 4 test, 23, or 51%, had been included on the 1974-75 test form. The testing instrument for the present assessment in Grade 8 included 32, or 49%, repeated items; 38, or 51%, of the items for the 1979-80 Grade 11 test form had been included in the 1974-75 assessment.

THE STUDENT QUESTIONNAIRE. A student questionnaire instrument was developed for each grade level. The purposes of these questionnaires were:

1) to identify student characteristics and student attitudes about science that might bear a relationship to achievement, and

2) to provide a general characterization of students that might prove useful in subsequent curriculum planning.

Although the final student questionnaire instruments were similar for the three grade levels, they were not identical. Eighteen items appeared on the student questionnaires for fourth-grade students; 16 questionnaire items were selected for the Grade 8 test form; and 29 questionnaire items were selected for inclusion on the Grade 11 test form. Questionnaires were printed at the front of each test booklet and were administered to all participating students.

Test Administration

Tests were administered in October and November 1979 for Grade 8, in February 1980 for Grade 4, and in April 1980 for Grade 11. Testing activities involved 115 schools in 69 school districts for Grade 4, 84 schools in 68 districts for Grade 8, and 66 schools in 55 districts for Grade 11. In total, student participation in testing activities numbered 2,513 for Grade 4, 2,612 for Grade 8, and 2,301 for Grade 11. Testing sessions lasted about 60 minutes. The test administration procedures were similar to those used by NAEP but did not include paced audiotapes accompanying the tests. To limit the burdens placed on school personnel, and to standardize administration procedures for the assessment, 11 Connecticut citizens with backgrounds in education were hired and trained by NES staff to conduct testing in the schools.

Sampling Design

PURPOSE. In order to provide information about the achievement performance of Connecticut students in a cost-effective manner, a sample of students was tested at each grade level. Students were selected for participation in the assessment according to a stratified sampling procedure. A more comprehensive description of the sampling design and procedures may be found in the Connecticut Assessment of Educational Progress Science Technical Report, which is available from the State Department of Education.

The sample was designed to be representative of students from schools included in each of the six Connecticut Educational Regions and the four sizes of communities defined below. Eligibility for participation was based on the following NAEP criteria:

(1) Students were not tested if they did not speak English or if they were handicapped (physically, mentally, or emotionally) in such a way that they could not respond to the test.

(2) Only fourth-graders born in 1970, eighth-graders born in 1966, or eleventh-graders born between October 1, 1962 and September 30, 1963 were eligible for testing.

STRATIFICATION VARIABLES. Categories of the size of community variable were defined as follows:

(1) "Big Cities" -- towns whose population exceeds 100,000 (Bridgeport, Hartford, New Haven, Stamford, and Waterbury)

(2) "Fringe Cities" -- towns which are contiguous with Big Cities and whose population exceeds 10,000 (e.g., East Hartford, Naugatuck, Trumbull)

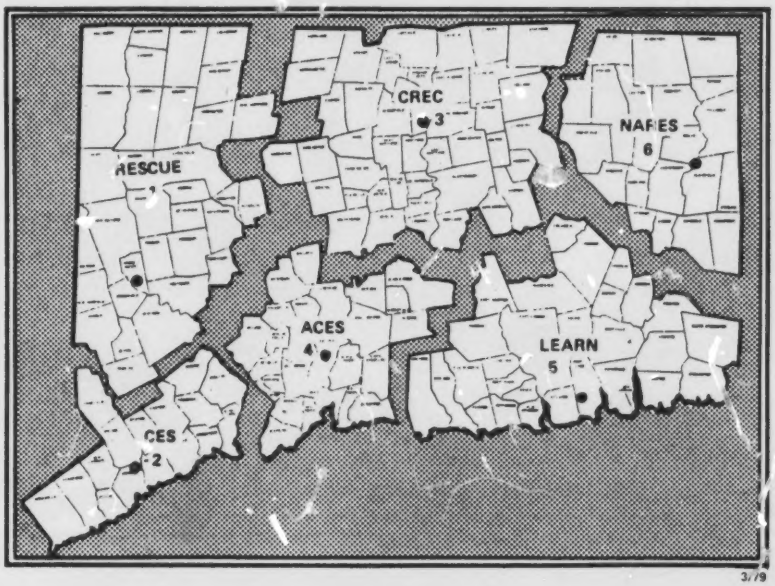
(3) "Medium Cities" -- towns whose population exceeds 25,000 and which are not Big Cities or Fringe Cities (e.g., Bristol, Manchester, Westport)

(4) "Smaller Places" -- all other towns (e.g., Bethany, Rocky Hill, Stafford)

Figure 1 below shows the division of the state into regions based on the six Connecticut Regional Educational Service Centers. Each region is identified in the key below the map.

FIGURE 1

MAP OF CONNECTICUT REGIONAL EDUCATIONAL SERVICE CENTERS



Region 1: Regional Educational Services Concepts (through) Unified Effort (RESCUE)
Region 2: Cooperative Educational Services (CES)
Region 3: Capital Region Educational Council (CREC)
Region 4: Area Cooperative Educational Services (ACES)
Region 5: Project LEARN (LEARN)
Region 6: Northeast Area Regional Educational Services (NARES)

SAMPLE COMPOSITION. Table 2 describes the composition of the sample for each grade level in terms of region and size of community. The sample is representative of the actual composition of the population. Appropriate statistical techniques ensure that the results described in this report represent best estimates of the "true" achievement scores which would have been obtained had all Connecticut students at the specified grade levels been tested.

Reporting the Results

Parts II through IV of this report describe the major outcomes of the science assessment in Grades 4, 8, and 11. For each grade level, achievement results are reported for all students on each item, for all items matched to each objective and goal area, and for all items on the total test. Chapters V and VI summarize the results of the student questionnaires. Interpretations and recommendations based on the assessment results are presented in Chapter VII. These recommendations should prove valuable to those people--legislators, administrators, classroom teachers, and laypersons--concerned with providing quality science education.

It should be emphasized that the results included in this report indicate the average performance of Connecticut students in Grades 4, 8, and 11. No results for individual schools or school districts are included. Only local assessment could serve that purpose. More in-depth information about the methodology and outcomes of the assessment may be found in the 1979-80 Connecticut Assessment of Educational Progress: Science Technical Report available at the Connecticut State Department of Education.

Understanding the Results

Many of the results presented in this report involve comparisons of scores for various purposes. These include comparing 1979-80 Connecticut scores with scores of previous CAEP and NAEP assessments, comparing scores of different grade levels on repeated items, and comparing scores of various reporting groups within Connecticut. In each of these cases, the score of one group is compared to that of another group.

Because the scores were generated on the basis of a sample of students, the score for each group should be considered an estimate of the true score of the population that the group represents (e.g., all fourth-graders or all eighth-graders in the state). This means that if, for example, the score for a group is reported as 61%, the true score of the population is likely to be either that score or very close to it. It would be safe to say that the true score is probably no more than two percentage points higher or lower than the reported score.

TABLE 2

Number of Participating Students in Each Grade Level by Stratum

Reporting Category	Actual Sample Size		
	Grade 4	Grade 8	Grade 11
TOTAL	2513	2612	2301
REGION			
RESCUE	266	298	238
CES	522	586	490
CREC	724	660	685
ACES	547	593	510
LEARN	267	303	250
NARES	187	172	128
SIZE OF COMMUNITY			
Big Cities	350	395	304
Fringe Cities	642	658	592
Medium Cities	584	632	647
Smaller Places	937	927	758

While there are many tables and graphs in this report, the narrative accompanying the tables highlights the more interesting findings of the assessment. Particular attention should be paid to the narrative, since it focuses on the most outstanding differences between groups.

In the interest of minimizing the importance of small differences between groups, the narrative will generally describe scores that vary by two percentage points or less as "about the same." Such small differences are not likely to be educationally meaningful.

Observed differences between groups do not indicate cause-effect relationships. Such relationships cannot be proved by the assessment data. While there may be a relationship between achievement and a given variable (e.g., sex of the student), the data do not indicate the reason or cause for the relationship.

The Local Option

The Local Option phase of the assessment allowed participating districts to examine in detail the achievement of their own students in a single class or throughout the district by contracting directly with NES. Results permitted local districts to (1) examine students, classes, schools, and districts as a whole; (2) examine special groups (e.g., male-female) utilizing precoding procedures provided by NES and (3) compare local achievement results with results gathered in this year's statewide testing, the 1974-75 assessment results, and national results. Thirty-three Connecticut school systems participated in the Local Option at one or more grade levels. Under this option, an additional 14,000 students were tested.

Services provided by NES to those districts participating in the Local Option were: training of test coordinators, delivery of test booklets, editing and scoring of tests, data analysis, computerized results reports, and assistance with interpretation of results. Individual district results were supplied to each participating district on a confidential basis. No district, school, or student results from the Local Option were reported to the State Department of Education.

CHAPTER II

1979-80 ACHIEVEMENT RESULTS

Introduction

To describe the achievement of Connecticut students in science, the assessment results include performance scores on each test item, objective, and goal area. Since the results are based on a representative sample, the achievement scores represent only best estimates of how well all Connecticut students would have scored. Statistical techniques indicate that these estimates are probably within two percentage points of the "true" scores of the population. Small differences between scores should not be overemphasized.

Comparisons of total test and goal area scores for the three grade levels should not be made except where noted in this report. It is possible, for example, that fourth-graders may have obtained a score indicating a higher percentage correct for the items administered at that grade level than eleventh-graders obtained on the items administered in Grade 11. However, this would not mean that fourth-graders outperformed the eleventh-graders. Comparisons among grade levels on total test results should <u>not</u> be made for the following reasons.

(1) The number of items administered at each grade level was different. Forty-five items were administered at Grade 4, 65 items administered for Grade 8, and 75 items administered to students in Grade 11.

(2) The set of items administered at each grade level was not identical. Although some items were repeated between grades, more than 60% of the items on each of the tests were unique to that specific grade level. Comparisons of achievement on repeated items are discussed later in this chapter.

(3) The level of difficulty of the items increased from Grade 4 to Grade 8 to Grade 11.

Achievement on the Total Test

Students in Grade 4 answered correctly an average of 61.3%, or 27.6, of the 45 test items on the test. In Grade 8, students answered correctly an average of 62.2%, or 40.4, of the 65 items on the test. Students in Grade 11 answered an average of 55.2%, or 41.4, of the 75 test items for Grade 11 correctly. Figure 2 presents student achievement on total test and goal areas for students in Grades 4, 8, and 11.

Achievement on Goal Areas and Objectives

OVERVIEW. The test items for each grade level were matched to one of the seven objectives listed in Table 1; each objective was grouped with other objectives to define a broader goal area. It is therefore possible to examine not only results for individual items, but also results of all items matched to a particular objective (for Grades 8 and 11) and for all items matched to a particular goal area. Results for Grade 4 are reported for goal areas only, because some Grade 4 objectives contained only one or two items. The reliability of objective results calculated for such a small number of items is questionable.

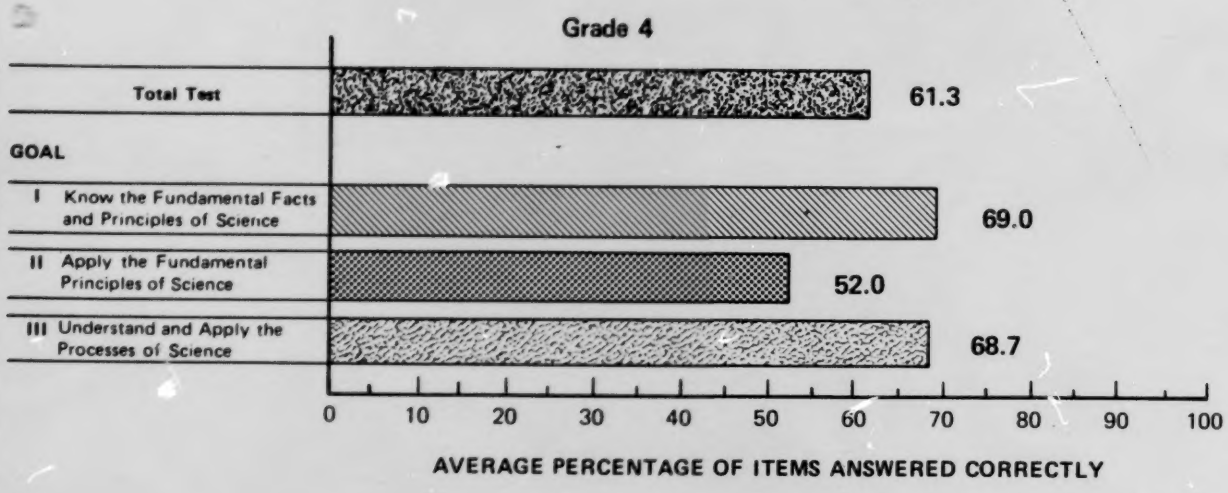
ACHIEVEMENT IN GRADE 4. Of the 45 test items for Grade 4, Goals I, II, and III included 10, 20, and 15 items, respectively. Students' performance ranged between 52.0% correct for Goal II (Apply the fundamental principles of science) to 69.0% correct for Goal I (Know the fundamental facts and principles of science). Students answered correctly an average of 68.7% of the items for Goal III (Understand and apply the processes of science).

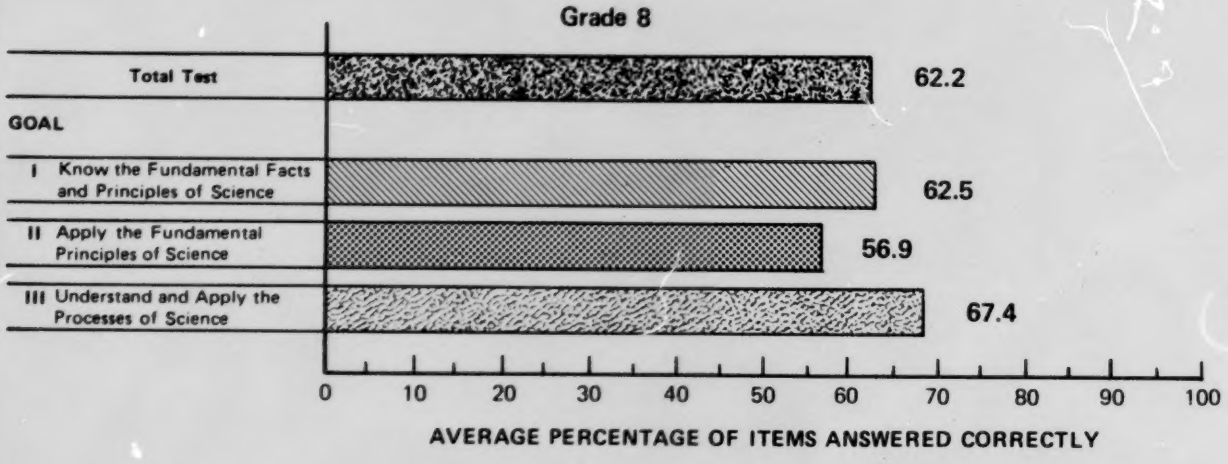
ACHIEVEMENT IN GRADE 8. For Grade 8, the number of items matched to Goals I, II, and III, was 22, 22, and 21, respectively. The average percentage of items answered correctly ranged from 56.9% for Goal II (Apply the fundamental principles of science) to 67.4% for Goal III (Understand and apply the processes of science). Students answered correctly 62.5% of the items matched to Goal I (Know the fundamental facts and principles of science).

Figure 3 shows student achievement on objectives for Grade 8. Of the 22 items included in Goal I, 11 items, 4 items, and 7 items were matched to Objectives 1, 2, and 3, respectively. Student performance on the objectives for Goal I ranged from 43.9% for Objective 2 (Know the fundamental facts and principles of physical science) to 69.2% for Objective 1 (Know the fundamental facts and principles of biological science).

FIGURE 2

Achievement on Total Test and Goal Areas by Grade Level


Grade 4
Total Test
61.3
GOAL
I Know the Fundamental Facts and Principles of Science
69.0
II Apply the Fundamental Principles of Science
52.0
III Understand and Apply the Processes of Science
68.7
0 10 20 30 40 50 60 70 80 90 100
AVERAGE PERCENTAGE OF ITEMS ANSWERED CORRECTLY


Grade 8
Total Test
62.2
GOAL
I Know the Fundamental Facts and Principles of Science
62.5
II Apply the Fundamental Principles of Science
56.9
III Understand and Apply the Processes of Science
67.4
0 10 20 30 40 50 60 70 80 90 100
AVERAGE PERCENTAGE OF ITEMS ANSWERED CORRECTLY

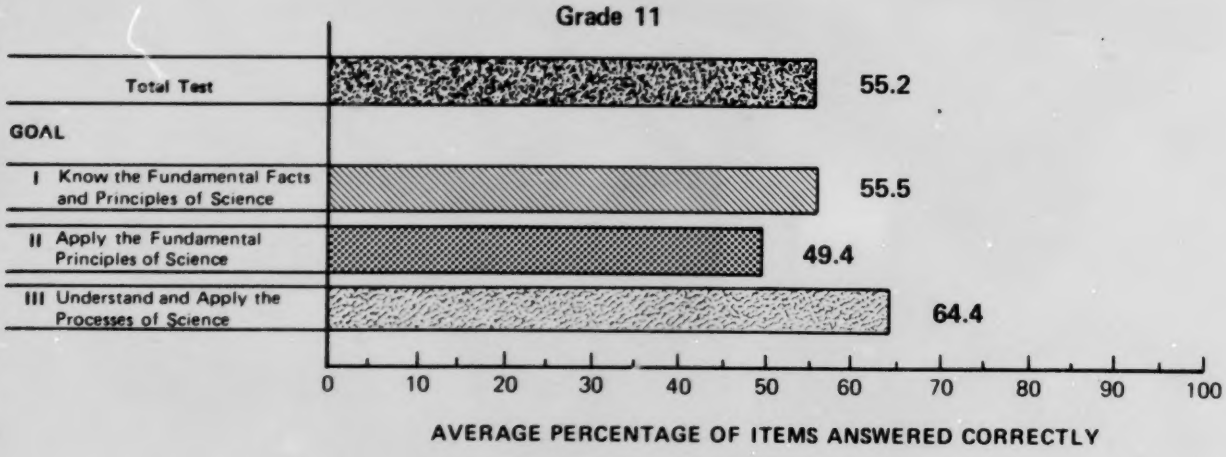
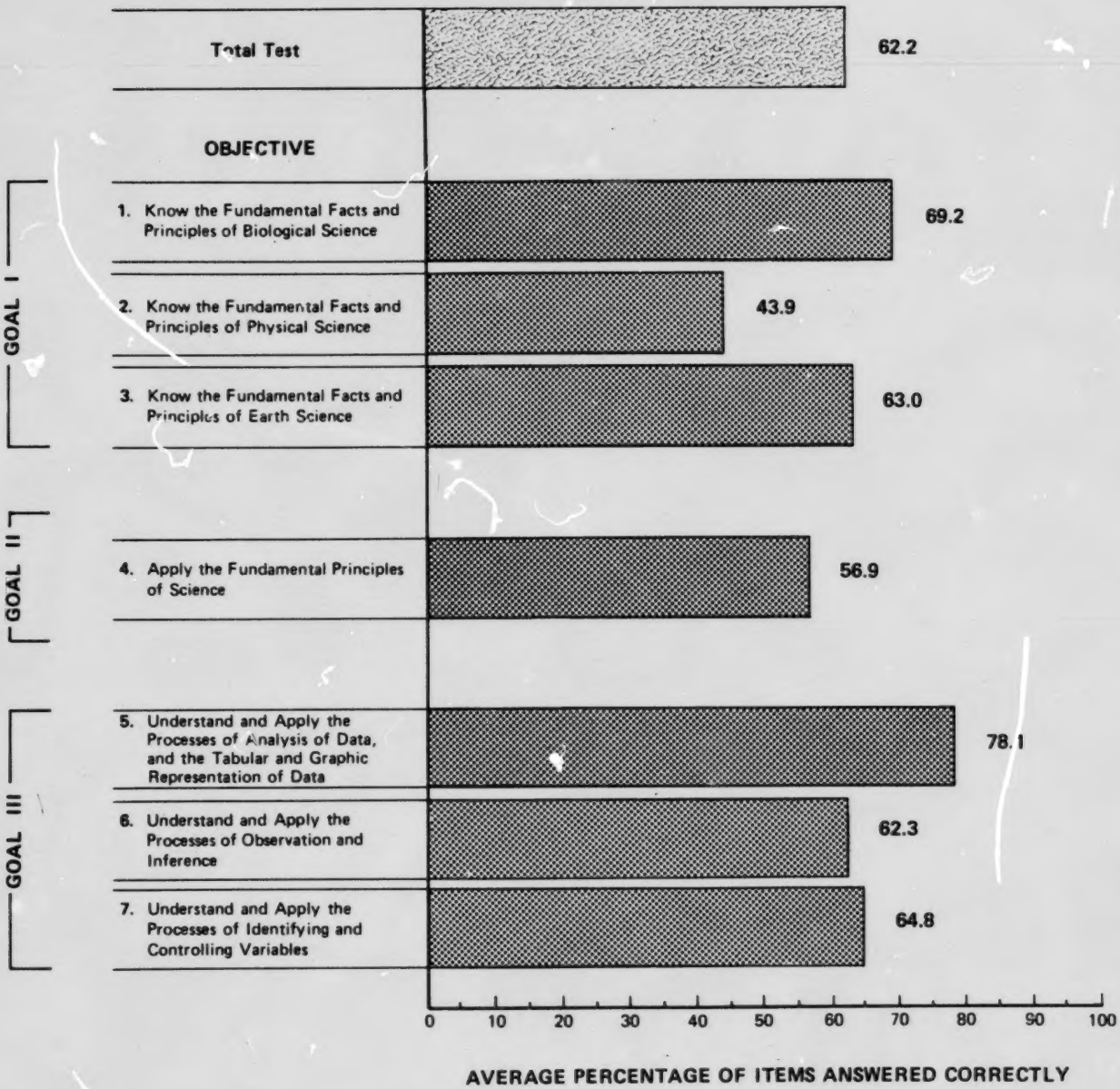

Grade 11
Total Test
55.2
GOAL
I Know the Fundamental Facts and Principles of Science
55.5
II Apply the Fundamental Principles of Science
49.4
III Understand and Apply the Processes of Science
64.4
0 10 20 30 40 50 60 70 80 90 100
AVERAGE PERCENTAGE OF ITEMS ANSWERED CORRECTLY

FIGURE 3

Achievement on Objectives for Grade 8


Total Test
62.2
OBJECTIVE
GOAL I
1. Know the Fundamental Facts and Principles of Biological Science
69.2
2. Know the Fundamental Facts and Principles of Physical Science
43.9
3. Know the Fundamental Facts and Principles of Earth Science
63.0
GOAL II
4. Apply the Fundamental Principles of Science
56.9
GOAL III
5. Understand and Apply the Processes of Analysis of Data, and the Tabular and Graphic Representation of Data
78.1
6. Understand and Apply the Processes of Observation and Inference
62.3
7. Understand and Apply the Processes of Identifying and Controlling Variables
64.8
0 10 20 30 40 50 60 70 80 90 100
AVERAGE PERCENTAGE OF ITEMS ANSWERED CORRECTLY

Since only Objective 4 was matched to Goal II, the objective score obtained by students is identical to the goal area score. Again, students answered correctly an average of 56.9% of the items correctly for Objective 4 in Goal II.

For the 21 items matched to Goal III, 6 items were included in Objective 5, 10 items matched to Objective 6, and 5 items included in Objective 7. Objectives scores ranged from 62.3% for Objective 6 (Understand and apply the processes of observation and inference) to 78.1% for Objective 5 (Understand and apply the processes of analysis of data, and the tabular and graphic representation of data).

ACHIEVEMENT IN GRADE 11. Of the 75 items included on the test for Grade 11, 27 items were matched to Goal I, 30 items matched to Goal II, and 18 items matched to Goal III. Student achievement on goal areas ranged from 49.4% for Goal II (Apply the fundamental principles of science) to 64.4% for Goal III (Understand and apply the processes of science) (see Figure 2). Students answered an average of 55.5% of the items correctly for Goal I (Know the fundamental facts and principles of science).

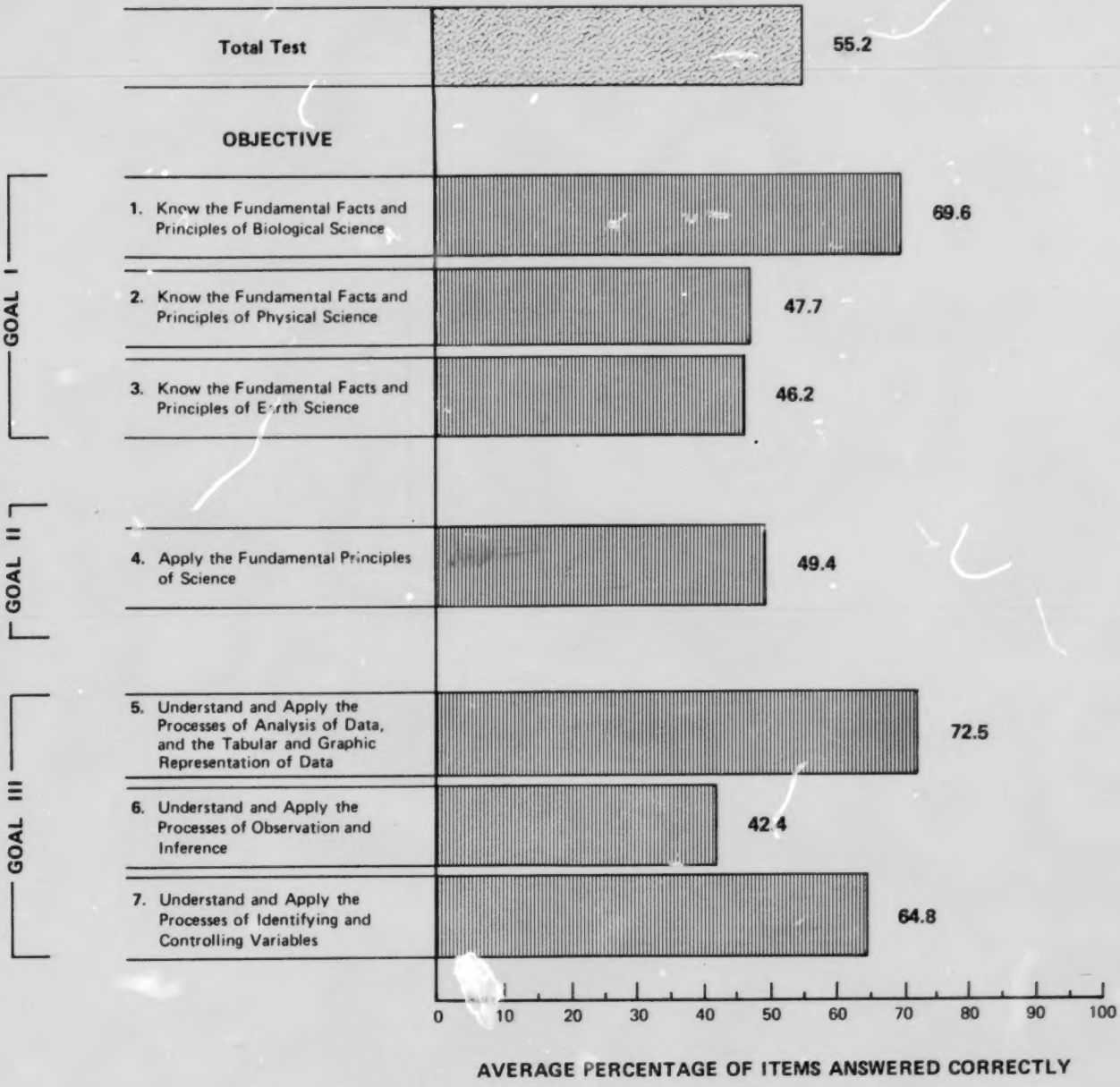
Figure 4 illustrates student objective achievement for Grade 11. Of the 27 items included in Goal I, 10 items, 11 items, and 6 items were matched to Objectives 1, 2, and 3, respectively. Achievement scores for these objectives ranged from 46.2% (Objective 3) to 69.6% (Objective 1).

As in Grade 8, the only objective included in Goal II for the Grade 11 test was Objective 4. On the average, students answered 49.4% of the items correctly for this objective/goal.

Objectives 5, 6, and 7 were matched to Goal III and consisted of 11 items, 4 items, and 3 items, respectively. Objective achievement scores ranged from 42.4% (Objective 6) to 72.5% (Objective 5).

FIGURE 4

Achievement on Objectives for Grade 11


Total Test
55.2
OBJECTIVE
GOAL I
1. Know the Fundamental Facts and Principles of Biological Science
69.6
2. Know the Fundamental Facts and Principles of Physical Science
47.7
3. Know the Fundamental Facts and Principles of Earth Science
46.2
GOAL II
4. Apply the Fundamental Principles of Science
49.4
GOAL III
5. Understand and Apply the Processes of Analysis of Data, and the Tabular and Graphic Representation of Data
72.5
6. Understand and Apply the Processes of Observation and Inference
42.4
7. Understand and Apply the Processes of Identifying and Controlling Variables
64.8
0 10 20 30 40 50 60 70 80 90 100
AVERAGE PERCENTAGE OF ITEMS ANSWERED CORRECTLY

Achievement on Items Across Age Groups

For comparison purposes, a number of items were selected for each test that were administered at more than one grade level. Ten identical items appeared on the tests for fourth- and eighth-graders; fifteen items were included on both the eighth- and eleventh-grade tests. One of these items was repeated for all three grade levels.

Table 3 shows the percentage of students answering correctly each of the items repeated across grade levels. For the 10 items common to Grades 4 and 8, students answered correctly an average of 52.5% of the items in Grade 4 and 74.2% of the items in Grade 8. For every item included on the two test instruments, student performance increased significantly (by at least five percentage points) at the Grade 8 level. Increase in student performance ranged from 5.3 to 41.3 percentage points which resulted in an average increase from Grade 4 to Grade 8 of 21.7 percentage points.

For the 15 items common to the tests for Grade 8 and Grade 11, the average student gain from Grade 8 to Grade 11 was 10.2 percentage points. Eighth-graders answered correctly 62.5% of these items whereas eleventh-graders answered correctly 72.7% of these items. All but three items (Items 3, 38, 57) showed a significant increase in achievement (a gain of at least five percentage points) from Grade 8 to Grade 11.

Item 38 was the item administered at all three grade levels which required students to predict the weight of a solution made up of one kilogram of salt and twenty kilograms of water. The percentage of students answering this item correctly was 50.8%, 56.1%, and 49.0% for Grades 4, 8, and 11, respectively. Students in Grade 8 outperformed students in both Grades 4 and 11 on this item. The older students were more likely to select the response which stated that the weight of the resultant mixture was unpredictable.

TABLE 3

Comparison of Achievement Across Grade Levels on Common Items by Goal Area

1979-80 CAEP Item Number	Percentage of Students Answering Correctly		
	Grade 4	Grade 8	Grade 11
Goal 1			
1		68.7	80.2
2		69.6	78.3
3		80.1	82.6 †
4		89.6	95.3
8	59.9	76.7	
9	71.5	84.6	
11	85.1	90.7	
20		31.6	44.1
Goal 2			
14	32.2	73.5	
24	47.7	71.1	
31	9.9	49.6	
36		70.2	79.2
37	59.4	74.5	
38	50.8	56.1	49.0
39		26.5	40.5
41	64.3	88.1	
Goal 3			
28		53.8	71.2
29	44.2	77.4	
35		25.0	48.7
49		58.2	74.4
51		52.3	70.9
56		72.2	86.3
57		93.6	94.3 †
58		90.1	95.5
Average score for 10 items common to Grades 4 & 8	52.5	74.2	
Average score for 15 items common to Grades 8 & 11		62.5	72.7

† indicates a non-significant difference between scores of Grade 8 and Grade 11 students

CHAPTER III

COMPARING CONNECTICUT WITH THE NATION AND THE NORTHEAST REGION

Introduction

In order to put into perspective the achievement of Connecticut students, their scores were compared to the scores of students in the nation and the Northeast. These students had been tested as part of the National Assessment of Educational Progress (NAEP), which assessed student performance in science in 1969-70, 1972-73, and 1976-77. All items included in this year's assessment were selected from the pool of items available from NAEP. Comparisons were made for individual items and for sets of items grouped by objectives, by goal area, and by total test at each grade level.

Interpretation of Results

Certain differences existed between the Connecticut and NAEP assessments that bear on the interpretation of results. First, no paced audiotapes were used for test administration in Connecticut; NAEP uses paced audiotapes for test directions and for every item.

Secondly, NAEP tests students at each age level regardless of the grade in which they are enrolled, while Connecticut tested 9-, 13-, and 17-year-olds enrolled only in Grades 4, 8, and 11, respectively. Thus, even though most 9-year-olds are in the fourth grade, some are in the third or fifth grades, and there are similar relationships between 13-year-olds and eighth-graders, and 17-year-olds and eleventh-graders. This discrepancy between the Connecticut and NAEP sampling methodology exists at all three age/grade levels, and presents a potential problem for any comparative analysis. In order to obviate this problem, NAEP recently began to report achievement results for students of the proper age within each grade level. These so-called "modal" data insure that comparisons are being performed between, for example, 9-year-old fourth-graders in Connecticut and 9-year-old fourth-graders in the nation. The comparisons reported below use the NAEP modal data wherever possible. However, for items from the two earlier NAEP science assessments, only age data are available for comparative purposes.

The third interpretation issue which should be considered involves the passage of time between the NAEP and CAEP assessments. As reported above, NAEP science assessments have occurred in 1969-70, 1972-73, and 1976-77. We are thus comparing 1979-80 statewide data to nationwide data which are from three to ten years old. This would not be an issue if scores were expected to remain constant from year to year. However, NAEP has reported a consistent decline in scores for those science items that have been administered in each assessment. This decline in scores has been most substantial at the higher grade levels. Thus, it is likely that the NAEP scores used for comparison purposes in this report are higher than scores which would have been obtained had NAEP performed a concurrent assessment in 1979-80. Thus, Connecticut has been placed in a comparative disadvantage due to the passage of time. The NAEP results used for comparison purposes in this report were in all cases the most recent data available for each item.

Summary of Results

Comparisons of statewide to nationwide results were performed at the item, objective, goal, and total test levels. Discussion in this report will focus upon the goal and total test levels. Item and objective comparisions may be found in the Connecticut Assessment of Educational Progress Science Technical Report. In addition, scores for the nation on each item are reported in Appendix A of this report.

COMPARISONS WITH THE NATION. Although each of the items on the CAEP tests were administered by NAEP, the group of items which constitute a test or a goal were not administered nationally at any one time to any one group of students. Therefore, there are no NAEP group statistics which permit statistical tests to be performed comparing Connecticut with NAEP performance at the goal or total test level. However, average performance of the two groups may still be compared. Figures 5, 6, and 7 illustrate average performance of Connecticut fourth-, eighth-, and eleventh-graders on total test and goal areas as compared to the nation.

Connecticut fourth-graders outscored their national counterparts by 1.7 percentage points in terms of the average percentage of all test items answered correctly. Performance by Connecticut fourth-grade students was better than the nation for 16, or 36%, of the test items, about the same as the nation for 23, or 51%, of the items, and below the nation for 6, or 13%, of the items. In addition, average goal scores for Connecticut fourth-graders were greater than those obtained by students nationwide by from 0.2 to 2.3 percentage points.

Average achievement by eighth-graders in Connecticut was about the same as the nation on total test and goal areas. Students in Connecticut answered correctly an average of 62.2% of the items while students nationwide answered 61.9% of the items correctly. This small difference in total test achievement is maintained in the goal area comparisons. On the three goal areas, Connecticut students scored from 0.7 percentage points below to 1.2 percentage points above students in the nation. Connecticut eighth-graders outperformed the nation on 20, or 31%, of the 65 test items, performed about the same as the nation on 31, or 48%, of the items, and below the nation on 14, or 22%, of the items.

Average achievement on the 75 test items administered to Connecticut eleventh-graders was about the same as the achievement for the national sample on these items. Connecticut students were able to answer correctly an average of 55.2% of the test items as compared to 56.8% answered correctly by students nationwide. In all, average student scores in Grade 11 were above the nation for 14, or 19%, of the items, about the same as the nation for 35, or 47%, of the items, and below the nation for 26, or 35%, of the items. However, performance of students in Grade 11 on Goal I was below the average achievement of the nation's 17-year-olds for this goal area by 3.1 percentage points. Scores for eleventh-graders on Goals II and III averaged within 2 percentage points of the national scores.

COMPARISONS WITH THE NORTHEAST. In the Northeast region, NAEP includes Maine, New Hampshire, Vermont, Massachusetts, Connecticut, Rhode Island, New York, New Jersey, Washington D.C., Pennsylvania, and Maryland. For Connecticut students in Grade 4, the average achievement on the total test was about the same as the achievement scores of their counterparts in the Northeast region (see Figure 5). The average score obtained by Connecticut students was 3.1 percentage points below the score for Northeast students on Goal I. On Goals II and III, scores for the two groups were about the same.

Performance by Connecticut students in Grade 8 was 2.1 percentage points below the performance of students in the Northeast on the total test. Figure 6 shows that this lower average achievement score for Connecticut students is due mostly to the lower average goal score obtained by Connecticut eighth-graders in Goal I. Students in Grade 8 performed about the same as their Northeast counterparts on Goals II and III.

As in Grade 8, Connecticut students in Grade 11 were outscored by their counterparts in the Northeast (see Figure 7). Students in Connecticut scored an average of 4.1 percentage points below 17-year-olds in the Northeast. Scores obtained by students in Grade 11 were lower than the Northeast for Goals I and II, by 5.8 and 3.8 percentage points, respectively. Connecticut students scored at about the same level as students in the Northeast for Goal III.

FIGURE 5

Comparing Connecticut, the Nation, and the Northeast by Total Test and Goal Areas

Grade 4

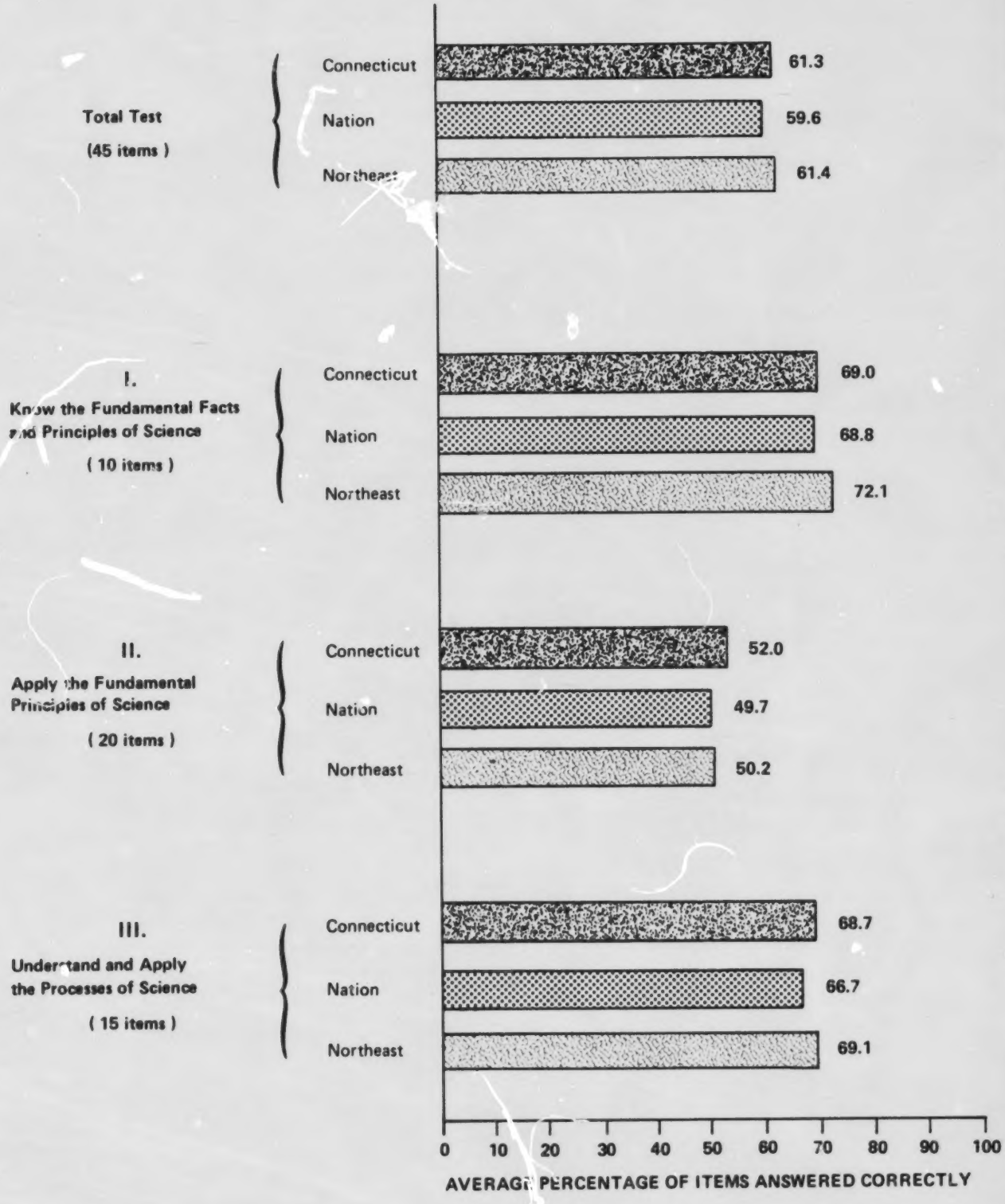


FIGURE 6

Comparing Connecticut, the Nation, and the Northeast by Total Test and Goal Areas

Grade 8

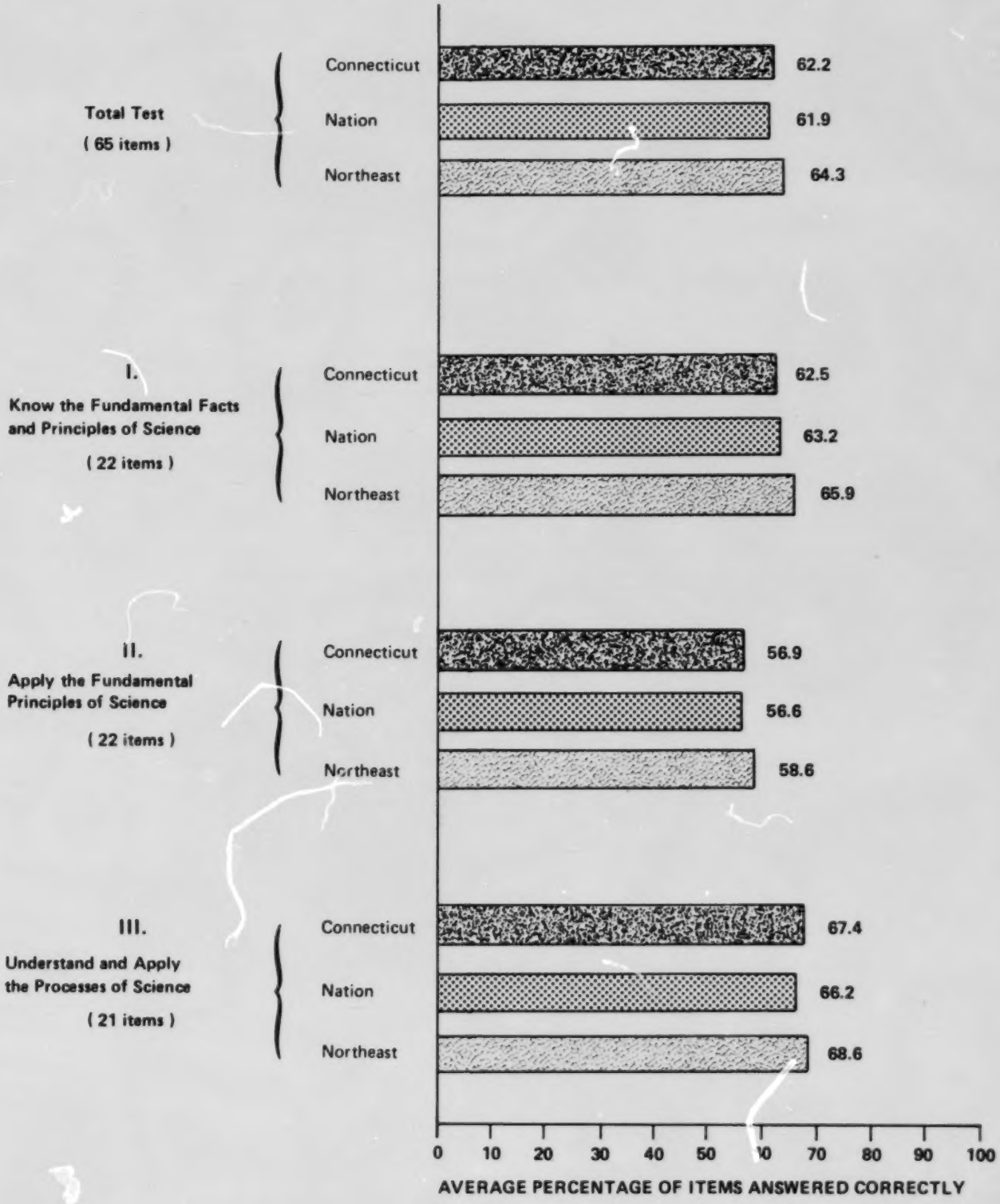
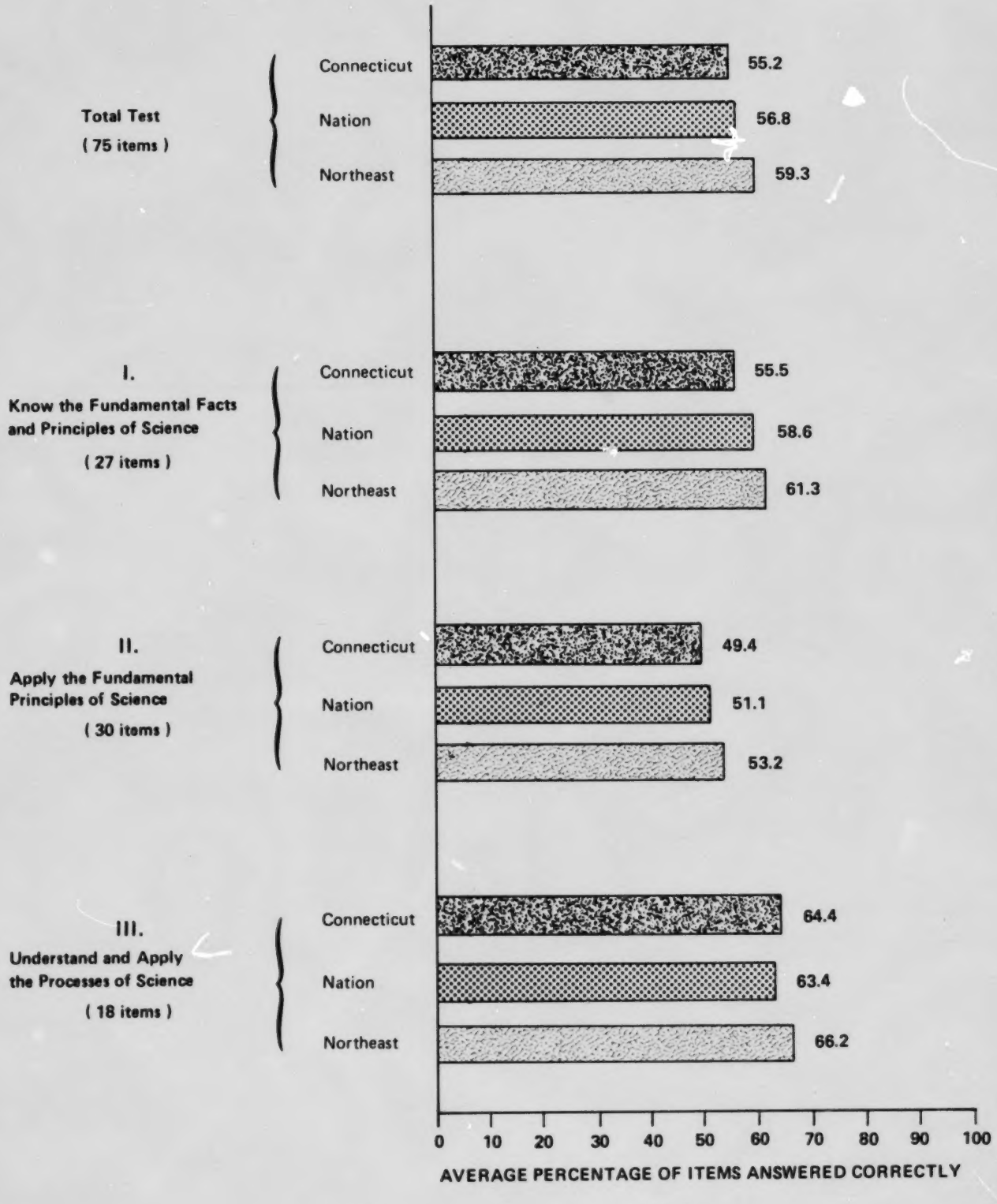


FIGURE 7

Comparing Connecticut, the Nation, and the Northeast by Total Test and Goal Areas

Grade 11



CHAPTER IV

COMPARISONS OF THE 1979-80 ACHIEVEMENT RESULTS WITH THE 1974-75 RESULTS

Introduction

Because Connecticut had conducted a science assessment in 1974-75, year-to-year achievement comparisons are possible for items administered in both assessments. Approximately 50% of the items for the 1979-80 administration were selected from the previous assessment. This resulted in the selection of 23 items for Grade 4, 32 items for Grade 8, and 38 items for Grade 11 from the 1974-75 assessment.

The results described here are for those items repeated for both the CAEP 1974-75 and CAEP 1979-80 science assessments. The narrative below will focus on goal and total test achievement comparisons. The item summary tables in Appendix A of this report contain item achievement data for both assessment years.

Interpretive Issues

As indicated in the previous chapter, results for CAEP 1979-80 are reported in terms of grade modal data. The previous CAEP science assessment collected and reported data following the NAEP model of testing students by age regardless of grade. This difference in testing methodology may have affected the following results. As described in the previous chapter, scores obtained in successive assessments conducted by NAEP have declined from the 1969-70 to the 1976-77 administrations, this decline being most substantial at the 17-year-old level. It is possible that the lower performance scores obtained in the CAEP 1979-80 administration as compared to CAEP 1974-75 may be partially attributed to a general trend reflected in the NAEP assessments. This issue was discussed previously in the introduction to Chapter III. Small differences between the item scores for comparison groups are not likely to be educationally meaningful.

Achievement Comparisons

Achievement scores for total test and goal areas computed for those items administered in both the 1974-75 and 1979-80 CAEP assessments may be found in Figures 8, 9, and 10. As indicated in these figures, average performance scores at each grade level have declined from the previous assessment by 3.3 to 4.9 percentage points.

Of the 23 items common to the Grade 4 tests in CAEP 1979-80 and CAEP 1974-75, students participating in the 1974-75 assessment answered correctly an average of 71.4% of the items. In the CAEP 1979-80 administration, students correctly answered an average of 68.1% of these items. The greatest decline in scores occurred for Goal III (Understand and apply the processes of science). For the 10 items repeated in this goal area, students in the 1974-75 CAEP assessment outperformed students in 1979-80 CAEP by an average of 5.9 percentage points. (Item scores from both assessment years appear in Appendix A of this report.)

For Grade 8, students in the CAEP 1974-75 administration outperformed students in the present assessment by 4.2 percentage points. Students in CAEP 1974-75 answered correctly an average of 61.9% of the items compared to 57.7% answered correctly by students in CAEP 1979-80. This decline is most evident in the achievement scores obtained by students this year on Goal II. Students' scores in this goal area declined by an average of 5.9 percentage points from the previous assessment (57.3% versus 51.4%). At the objective level, a significant decline in scores occurred between the two assessment years for Objective 3 (Know the fundamental facts and principles of earth science). For the three repeated items in this objective, students in CAEP 1979-80 scored an average of 5.3 percentage points lower than students in CAEP 1974-75 (see Appendix A).

For Grade 11, the average decline in scores from CAEP 1974-75 to CAEP 1979-80 was 4.9 percentage points. On the average, students in the 1974-75 administration answered correctly 55.9% of the 38 repeated items while students participating in this year's assessment answered correctly 51.0% of these items.

The greatest decline in scores for Grade 11 occurred in Goal I. Goal I scores for students this year averaged 5.5 percentage points below the goal scores obtained by students in the previous assessment. Decline in objective scores for this goal area ranged from 5 percentage points (Objective 2) to 10.2 percentage points (Objective 3) below the previous assessment's objective scores.

Students in CAEP 1979-80 also scored below their 1974-75 counterparts for Goal II by an average of 5.3 percentage points. By comparison, Goal III scores for repeated items in the two assessment years were about the same. The average score for Goal III in 1979-80 was only 1.7 percentage points below that of the 1974-75 participants (see Appendix A).

FIGURE 8

Year-to-Year Comparisons for Repeated Items

Grade 4

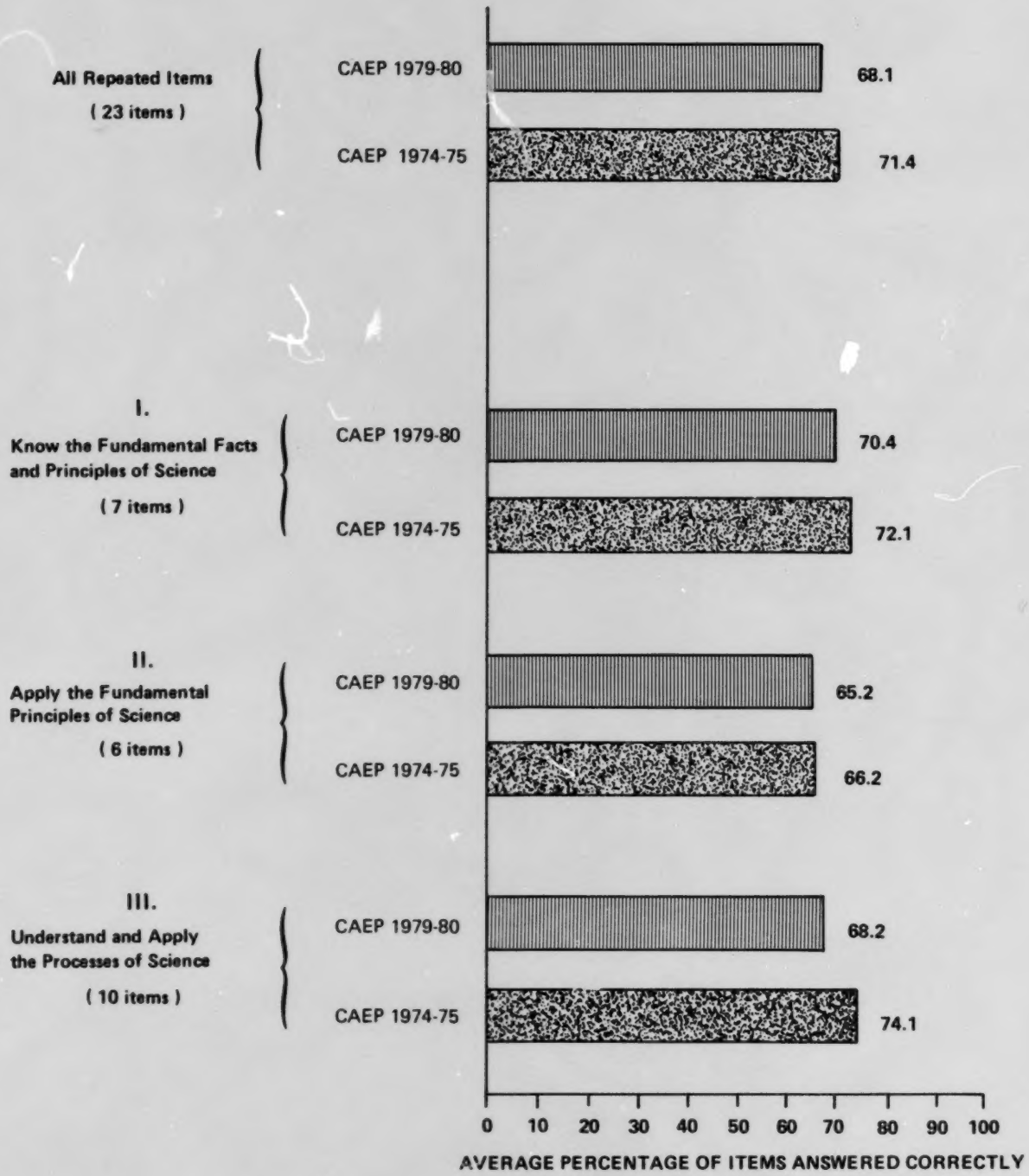


FIGURE 9

Year-to-Year Comparisons for Repeated Items

Grade 8

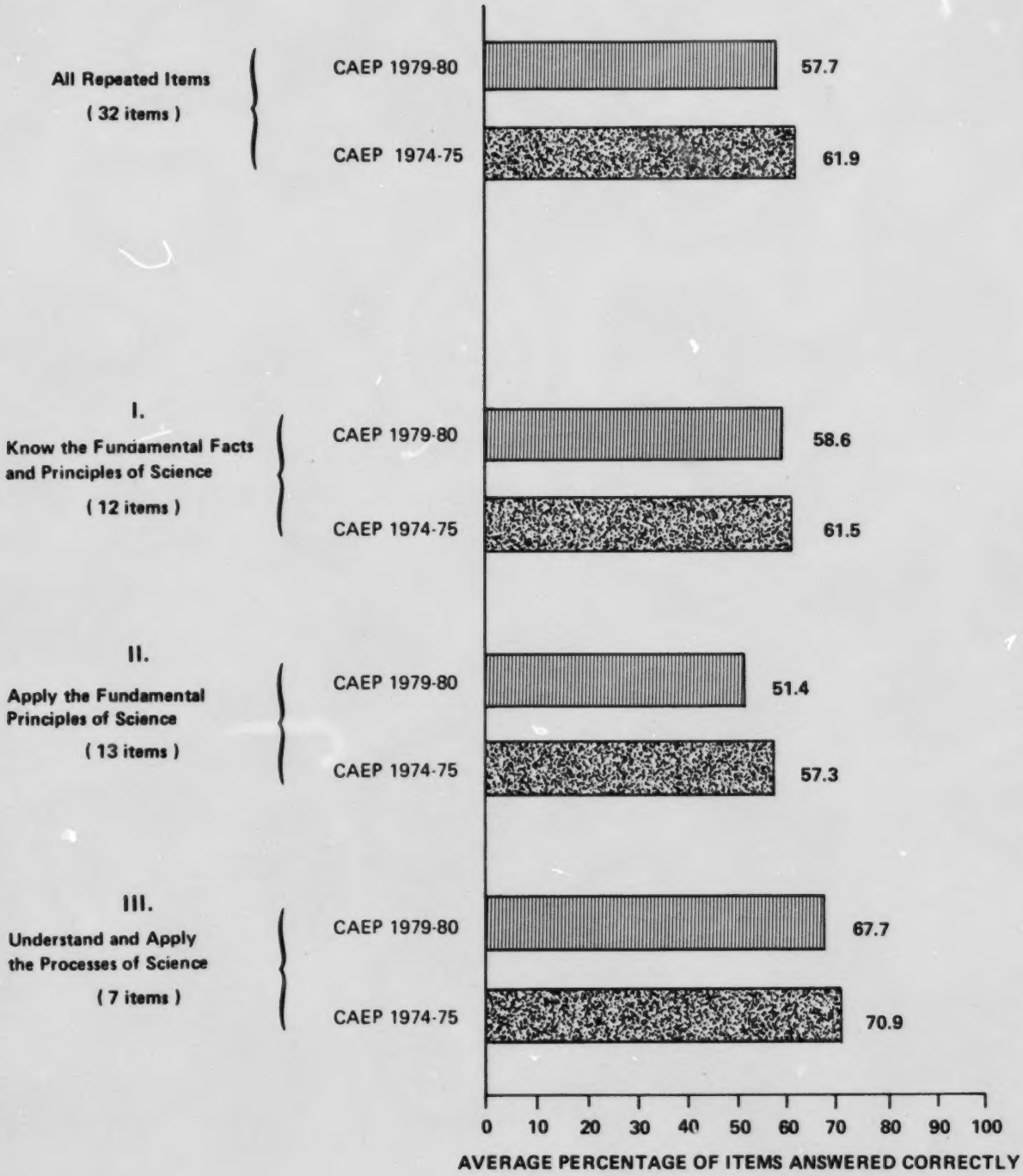
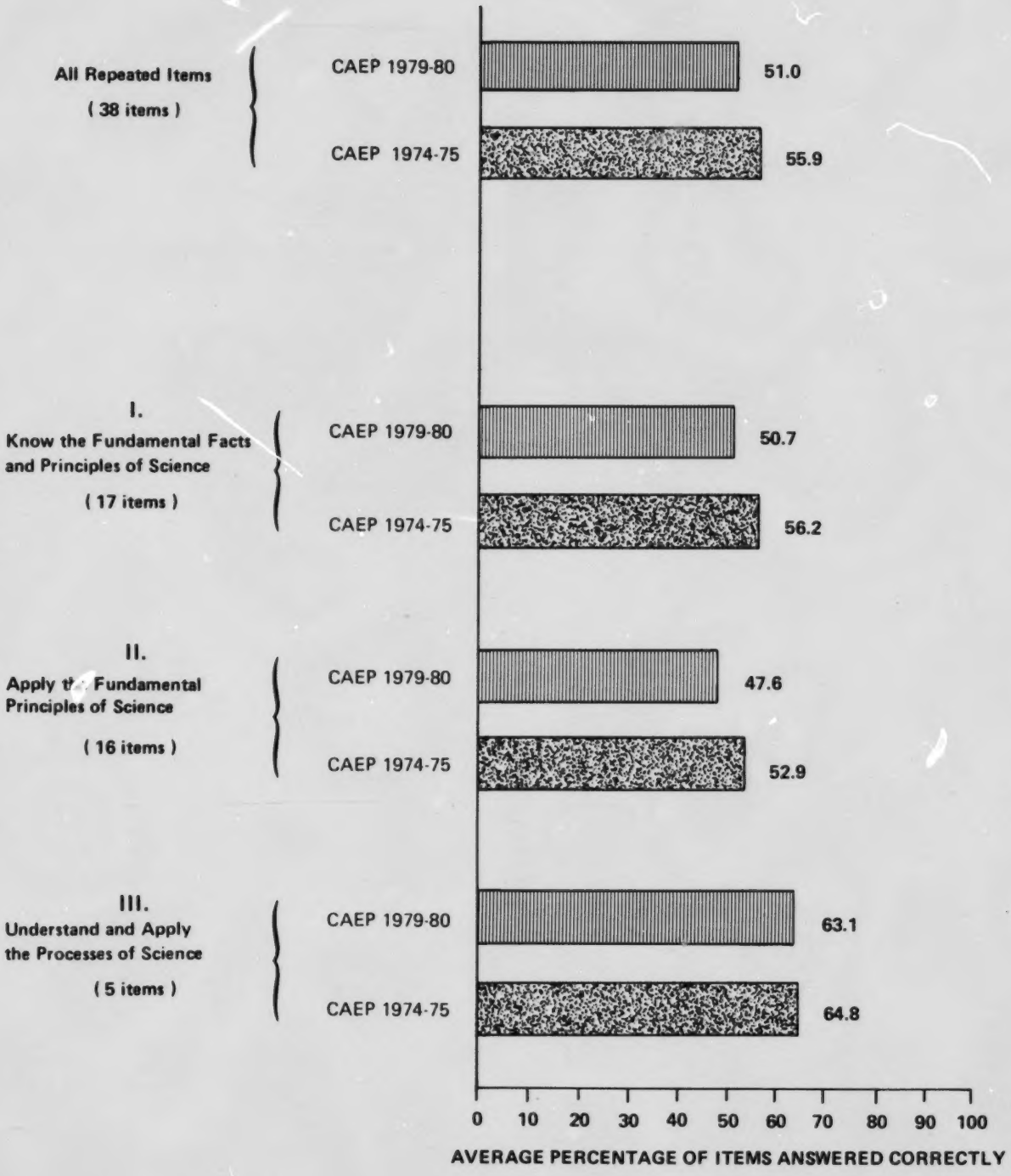


FIGURE 10

Year-to-Year Comparisons for Repeated Items

Grade 11



CHAPTER V

COMPARING TOTAL TEST ACHIEVEMENT BY SIZE OF COMMUNITY AND REGION OF THE STATE

Introduction

The purpose of this section is to describe and compare the achievement of selected groups of students within Connecticut. The selected groups are defined on the basis of the two stratification variables discussed in Chapter I: size of community and region of the state. Achievement is defined as performance on the total test; that is, the average percentage of all items on the test answered correctly.

The average for each size-of-community group is compared to the statewide average for all students at the appropriate grade level. Asterisks indicate those differences in scores that are statistically significant. However, statistical significance is not to be equated with educational meaningfulness. Small differences between groups may be statistically significant in one case and not in another due to a variety of factors, such as differing sample sizes. However, even where statistically significant, differences may be too small to be educationally meaningful. What is educationally meaningful depends on judgments about the practical implications of given differences in scores.

Further, observed differences do not indicate cause-effect relationships. The differences observed reveal only a relationship between a given factor and achievement, not that the factor causes differences in achievement.

Summary of Results for Stratification Variables

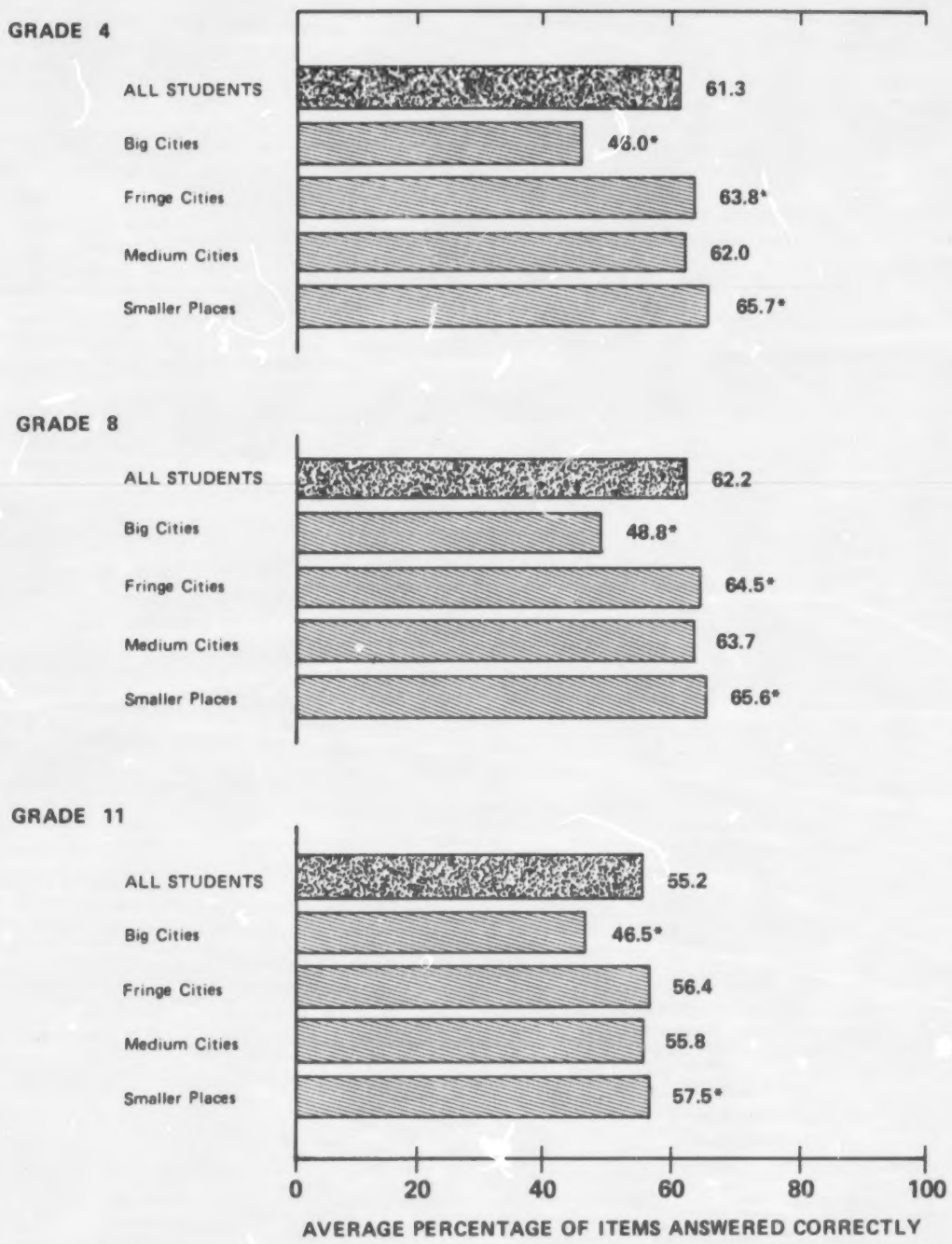
SIZE OF COMMUNITY. Figure 11 displays the results by size of community. Scores of students in Smaller Places for all grades and students in Fringe Cities for Grades 4 and 8 exceeded the statewide average by 2 to 4 percentage points. In accordance with the findings of previous assessments, performance of students who reside in "Big Cities" was substantially lower than that of students statewide. This difference was most pronounced at the fourth-grade level, where Big-City residents scored 15 percentage

points below the statewide average. The difference was still substantial at the higher grade levels, where Big City students scored about 13 and 9 percentage points below the statewide average for Grades 8 and 11, respectively.

REGION OF THE STATE. Figure 12 displays the results by region of the state. In order to make fair comparisons among the scores for the six regions of the state, the scores of students who live in big cities were not included when computing regional averages. Because there are no big cities in three of the regions, and because the scores of Big-City students tend to differ from those of other students, it was felt that in this assessment (as in previous Connecticut assessments) comparisons among the regions should be made for non-Big-City students only. Figure 12 shows the average scores for non-Big-City students in each region, as well as the average score for all non-Big-City students and for all students. At all grade levels, average total test scores for the non-Big-City students in each of the regions tended to be quite close.

FIGURE 11

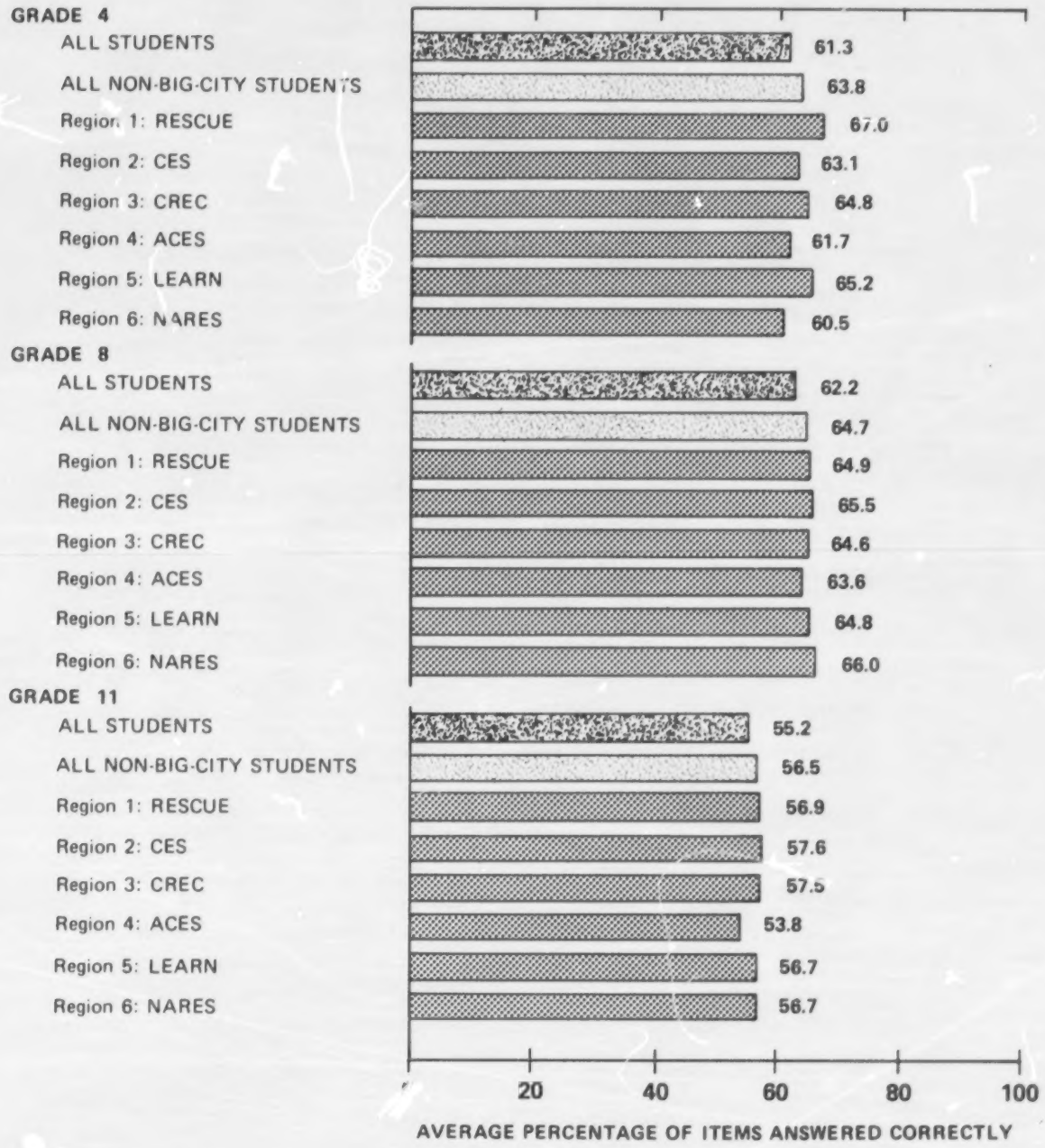
Achievement on Total Test by Size of Community



* Represents statistically significant difference between size of community and statewide average.

FIGURE 12

Achievement on Total Test by Region Excluding Big City Students



NOTES: (1) Summary results are shown in two ways- first for all students and then for all students except those who reside in Big Cities. (2) Results by region do not include Big Cities because the scores of Big-City students tend to differ from those of students in their respective regions, according to information from previous assessments in Connecticut.

CHAPTER VI

HIGHLIGHTS OF THE STUDENT QUESTIONNAIRE

Introduction

There are two ways in which student questionnaire results may be used. First, students can be grouped on the basis of their questionnaire responses, and the test achievement of the resulting "reporting groups" may then be compared (i.e., an "achievement analysis"). Second, an examination of the responses may, in itself, provide a policy-relevant characterization of students and student attitudes regarding science education throughout Connecticut (i.e., a "survey analysis"). In the first part of this chapter, those student questionnaire variables which were found to bear a relationship to achievement are discussed. For each of these variables, both achievement and survey data are presented. In the next part of the chapter, additional student questionnaire variables are discussed in terms of survey data only. Complete questionnaire data may be found in the Connecticut Assessment of Educational Progress Science Technical Report.

Summary of Results for Student Questionnaire Reporting Variables

The average percentage of test items answered correctly was computed for each student group. In each case, the average total test score for the group is compared to the average score for all students at that grade level within Connecticut.

Table 4 presents the average performance for each of the selected reporting groups. The narrative in this section will focus on those differences which were statistically significant. On the accompanying table, these statistically significant differences are indicated by asterisks. The cautionary statements, presented in the previous chapter regarding statistical significance, educational meaningfulness, and cause-effect relationships, apply to these findings as well.

TABLE 4

Achievement by Student Questionnaire Reporting Groups

Reporting Group	Average Percentage of Items on the Total Test Answered Correctly		
	Grade 4	Grade 8	Grade 11
ALL STUDENTS STATEWIDE	61	62	55
1. Are you a			
boy?	63 *	65 *	60 *
girl?	60 *	60 *	51 *
2. How do you feel about science compared to the other things you study in school?			
Science is my least favorite.	55 *	53 *	45 *
Science is not one of my favorites.	60 *	61	52 *
Science is one of my favorites.	64 *	64 *	61 *
Science is my favorite.	58 *	63	67 *
3. Do you think science will make life better for you and your family?			
Yes	62 *	--	--
No	58 *	--	--
4. How valuable do you feel the study of science and technology is to society?			
Useless	--	50 *	41 *
Not very valuable	--	51 *	44 *
Valuable	--	60 *	52 *
Very valuable	--	67 *	59 *

* represents statistically significant difference between group and statewide average

NOTE: Questionnaire items have been renumbered for this table. These item numbers DO NOT correspond with the original item numbers.

TABLE 4 (continued)

Achievement by Student Questionnaire Reporting Groups

Reporting Group	Average Percentage of Items on the Total Test Answered Correctly		
	Grade 4	Grade 8	Grade 11
ALL STUDENTS STATEWIDE	61	62	55
5. How valuable do you feel your science courses will be to you after you have finished high school?			
Useless	--	--	45 *
Not very valuable	--	--	50 *
Valuable	--	--	58 *
Very valuable	--	--	64 *
6. When was the last time you had a science course?			
Two years ago or longer	--	--	40 *
Last year	--	--	48 *
I am taking one or more this year.	--	--	61 *
7. Class discussions of science topics.			
I like class discussions of science topics very much.	61	65 *	60 *
Class discussions of science topics are okay.	62 *	61 *	55
I do not like class discussions of science topics.	57 *	57 *	48 *
8. Actually doing laboratory experiments.			
I like to do experiments very much.	62 *	63 *	57 *
Doing experiments is okay.	55 *	58 *	53 *
I do not like to do experiments.	57	51 *	48 *

* represents statistically significant difference between group and statewide average

TABLE 4 (continued)

Achievement by Student Questionnaire Reporting Groups

Reporting Group	Average Percentage of Items on the Total Test Answered Correctly		
	Grade 4	Grade 8	Grade 11
ALL STUDENTS STATEWIDE	61	62	55
9. How many times EACH WEEK do you study science?			
Never	54 *	--	--
Once a week	59 *	--	--
Twice a week	64 *	--	--
Three times a week	65 *	--	--
Four times a week	62	--	--
10. In your science class, how much of the time do you actually spend on activities such as working with plants and animals, using chemicals, or performing experiments?			
Never or hardly ever	--	56 *	--
Once or twice a month	--	62	--
Once or twice a week	--	64 *	--
Just about every day	--	63	--
11. In your science classes, how much of the time do you actually spend on activities such as gathering data, conducting experiments, or using science equipment?			
Never or hardly ever	--	--	46 *
Once or twice a month	--	--	54 *
Once or twice a week	--	--	59 *
Just about every day	--	--	54

* represents statistically significant difference between group and statewide average

TABLE 4 (continued)

Achievement by Student Questionnaire Reporting Groups

Reporting Group	Average Percentage of Items on the Total Test Answered Correctly		
	Grade 4	Grade 8	Grade 11
ALL STUDENTS STATEWIDE	61	62	55
12. Do you have a hobby at home connected with any of the things you study in science?			
Yes	62	64 *	59 *
No	61	61 *	54 *
13. How much do you enjoy watching a show about science on television or visiting a science museum?			
I like these very much.	63 *	67 *	63 *
I think these are okay.	61	61 *	54 *
I don't like these.	52 *	58 *	48 *

* represents statistically significant difference between group and statewide average

Summary of Results for Additional Reporting Variables

1. SEX OF STUDENT. At all grade levels, males outperformed females. However, this difference was more pronounced at the upper grade levels, ranging from approximately 3 percentage points at Grade 4 to 5 percentage points at Grade 8 to 9 percentage points at Grade 11.

   In Grades 4 and 8, 46% of the students in the sample were male, while 54% were female. In Grade 11, 48% of the students were male and 52% female.

2. ATTITUDE TOWARD SCIENCE. At the eleventh-grade level, students who indicated that science was their "least favorite" subject scored about 10 percentage points below the statewide average, while those who said it was their "favorite" subject outscored the statewide average by 12 percentage points. The same relationship was found at the eighth-grade level although the differences between groups were smaller. In Grade 4, students who claimed that science was their "favorite" subject scored 3 percentage points below the statewide average, while fourth-graders who said that science was "one of their favorite" subjects scored 3 percentage points above the statewide average.

   Students' reported attitude toward science was generally more favorable at the lower grade levels. About 70% of the fourth-graders, 60% of the eighth-graders, and 45% of the eleventh-graders reported that science was either "one of their favorite" subjects or their "favorite" subject.

VALUATION OF SCIENCE.

3. Value to family life: Students in Grade 4 who indicated that they felt science would make life better for themselves and their families scored an average of 4 percentage points higher than students who did not believe this to be true. Only 12% of the fourth-graders responded negatively to this item.

4. Value to society: Students in Grades 8 and 11 were asked a similar question regarding the study of science and its value to society. In general, achievement scores at both grade levels were higher when valuation of science was more positive. The average scores of students who considered the study of science to be "very valuable" exceeded the statewide average by 4 to 5 percentage points. Achievement scores for all other categories of response were below the statewide average by from 2 to 3 percentage points (for students who said the study of science was "valuable") to as much as 12 to 14 percentage points (for students who said the study of science was "useless").

Fewer than 10% of the students in the eighth and eleventh grades indicated that they felt the study of science to be "not very valuable" or "useless." Of the remaining students about 41% and 53% of the students in Grades 8 and 11, respectively, chose the "very valuable" response to this question.

5. Value to student: Generally, achievement scores were higher when student perceptions of the value of science courses taken in school were more positive. Performance of students in Grade 11 who felt that science courses taken in school would be "very valuable" after graduation exceeded the statewide average by 9 percentage points, while the average score of students who saw these courses as "useless" was below the statewide score by approximately the same amount.

   Although only 7% of the students considered their science courses to be "useless," about as many students considered these courses to be "not very valuable" (36%) as considered the courses to be "valuable" (39%). The percentage of students choosing the "very valuable" response was 18%.

6. Most recent enrollment in a science course. Students who reported that they were presently taking a science course scored 6 percentage points above the statewide average. By contrast, those students who were last enrolled in a science course one year ago performed 7 percentage points below the state; achievement was 15 percentage points below the state for students whose most recent enrollment in a science course was two years previous to testing.

   More than half of the students (59%) reported that they were presently taking a science course. Only 7% of the students said that they were last enrolled in a science course two years ago or longer.

CLASSROOM SCIENCE ACTIVITIES.

7. Class discussion of science topics. Students in all grades who responded that they did not like class discussion of science topics performed significantly below the statewide average by from 4 to 7 percentage points. Students in Grades 8 and 11 who enjoyed class discussions performed better than the statewide average.

For each grade level, more students chose the response indicating that class discussions were "okay" than any other response category for this item (50%, 62%, and 60% for Grades 4, 8, and 11, respectively). While 42% of the fourth-graders liked class discussions of science activities, 29% of the eighth-graders and 26% of the eleventh-graders reported enjoying this activity.

8. Actually doing laboratory experiments: For all grade levels, those students who indicated that they liked doing laboratory experiments scored slightly above the statewide average, by from 1 to 2 percentage points. The achievement scores of students who either felt this activity was "okay" or "did not like" doing experiments ranged from two to eleven percentage points below the statewide average.

   At each grade level, most students indicated that they enjoyed doing laboratory experiments. The percentage of students indicating that they enjoyed this activity ranged from 85% for Grade 4 to 77% for Grade 8 to 57% for Grade 11. Fewer than 7% of the students at any grade level indicated that they did not enjoy performing experiments.

9. Time spent on science, fourth-graders: The performance of Grade 4 students who reported that they studied science two to three times a week was up to 4 percentage points above the statewide average. By contrast, students who indicated that they either studied once a week or never studied science averaged 2 to 7 percentage points below the state. Students who indicated that they studied science four times a week or more performed at about the statewide average.

   Less than 9% of the students responded that they never studied science. The percentage of students included in the other response categories ranged from 18% to 26%.

10. and 11. Time spent on science activities, Grades 8 and 11: Students at both upper grade levels who "never or hardly ever" spent time on science activities scored as much as 9 percentage points below the statewide average, while students who spent time on science activities "once or twice a week" averaged at least two percentage points above the statewide scores. Student performance averaged about the same as the state if time was spent on these science activities "daily."

    About one-third of the students at each grade level said that they actually worked with science materials once a month or less often. About twice as many eighth-graders (24%) as eleventh-graders (13%) reported engaging in this type of activity on a daily basis.

EXTRA-CURRICULAR SCIENCE ACTIVITIES.

12. Science hobbies: In Grades 8 and 11, students who indicated that they had a science hobby outperformed the statewide average by 2 to 4 percentage points; this difference was larger at the upper grade level. Students who did not have a science hobby at these two grade levels scored about 1 percentage point below the statewide average. No difference in achievement scores was found for Grade 4 on this variable.

    Approximately half of the students in Grade 4 indicated that they had a science hobby. By contrast, about one-fourth of the students in Grades 8 and 11 engaged in a science hobby.

13. Recreational activities: This questionnaire item asked students how much they enjoyed visiting a science museum or watching a television show about science. Achievement markedly increased at each successive grade level with respect to enjoyment of these activities. Students who enjoyed watching a television show about science or visiting a science museum outperformed the statewide average by 2 percentage points (Grade 4), 5 percentage points (Grade 8), or 8 percentage points (Grade 11). By comparison, the performance of students who replied that they did not enjoy these activities was below the statewide average by from 4 to 9 percentage points.

    Consistent with student interest for other science activities, student interest in this activity was lower in Grades 8 and 11. While 44% of the students in Grade 4 indicated that they enjoyed watching a television show or visiting a museum, approximately half as many students in Grades 8 and 11 indicated a similar interest.

Summary Profiles

In order to further summarize the information presented in this chapter, profiles of those student questionnaire characteristics found to be related to achievement are presented below for each grade level.

Students in Grade 4 who tended to outperform the statewide average were those who:

- were male
- said science was one of their favorite subjects
- said they studied science two or three times a week

Students in Grade 4 who tended not to perform as well as the statewide sample were those who:

- were female
- said science was their least favorite or most favorite subject
- did not believe science can make life better
- did not like class discussions about science topics
- felt that doing laboratory experiments is "okay"
- said that they studied science only once a week or less often
- did not like visiting a museum or watching a television show about science

Students in Grade 8 who tended to outperform the statewide sample were those who:

- were male
- said science was one of their favorite subjects
- considered the study of science very valuable to society
- enjoyed class discussions about science topics
- enjoyed visiting a museum or watching a television show about science

Students in Grade 8 who tended not to perform as well as the statewide sample were those who:

- were female
- said science was their least favorite subject
- did not enjoy class discussions about science topics
- felt that doing laboratory experiments is "okay" or did not enjoy doing laboratory experiments
- said they hardly ever spent time on science activities
- did not enjoy visiting a museum or watching a television show about science

Students in Grade 11 who tended to outperform the statewide sample were those who:

- were male
- said science was either one of their favorites or their favorite subject
- felt that the study of science is very valuable to society
- felt that science courses will be valuable or very valuable after they leave school
- were presently taking a science course
- enjoyed class discussions about science topics
- enjoyed doing laboratory experiments
- spent time on science activities once or twice a week
- said they have a science hobby
- enjoyed visiting a museum or watching a television show about science

Students in Grade 11 who tended not to perform as well as the statewide sample were those who:

- were female
- said science was one of their least favorite subjects
- felt that the study of science was either not valuable or useless to society
- felt that science courses will not be valuable or will be useless
- last took a science course last year, or two years ago or more
- did not enjoy classroom discussions about science topics
- felt that doing laboratory experiments is "okay" or do not like doing them
- hardly ever spent time on science activities
- did not enjoy visiting a museum or watching a television show about science

Additional Highlights of the Student Questionnaire

The first parts of this chapter contained a discussion of those questionnaire variables which were shown to bear a relationship to achievement. In addition, an examination of the responses to other questionnaire responses may provide a policy-relevant characterization of students and student attitudes regarding science throughout Connecticut. Highlights of these questionnaire responses are presented in the rest of this chapter.

CLASSROOM ACTIVITIES. Student enjoyment of a number of science classroom activities was questioned. These activities included lectures, class discussions, reading books, doing laboratory experiments, and watching the teacher do experiments. Consistently for each activity, a greater percentage of students in Grade 4 than in either Grade 8 or 11 reported enjoying science activities.

- Actually doing laboratory experiments: Student response to this activity was more positive than for any other activity listed. The percentage of students responding that they liked to do experiments "very much" was 85%, 77% and 57% for Grades 4, 8, and 11, respectively.

- Lectures about science: This activity appeared to be least popular with students in Grades 4 and 8, and second least popular with eleventh-graders. Although one-quarter of the students in Grade 4 said that they liked this activity, only 6% of the eighth-graders and 5% of the eleventh-graders reported liking this activity.

-- Reading school books about science: While almost half (49%) of the fourth-graders liked this activity, this was true for only 11% of the students in Grade 8. This activity was least popular with the students in Grade 11; only 4% of these students indicated that they liked this activity.

USE OF THE METRIC SYSTEM. In Grade 8, most students (83%) reported that they use either the metric system alone or both the metric and customary systems of measuring in their study of science. (This question appeared on the Grade 8 questionnaire only.)

SCIENCE COURSE OFFERINGS. Most students in Grade 11 (80%) said that their school offered a sufficient number or variety of science courses. (This question appeared on the Grade 11 questionnaire only.)

ATTITUDE TOWARD SCIENCE, GRADE 11.

-- Right of the public to question scientific findings: Three-fourths of the students in Grade 11 agreed that the scientist is willing to let people test or question what he or she believes is true.

-- Ability of science to control nature: About half of the students agreed that science helps us to control the forces of nature. One-third of the students disagreed with this statement, while the remainder (17%) were undecided.

-- Ability of science to tell us right from wrong: Most students (62%) agreed that science does NOT tell us right from wrong in our relations with people. Of the remaining students, about as many students were undecided concerning this statement (21%) as disagreed with this statement (17%).

-- Ability of science to solve societal problems: More than half of the students (55%) disagreed with the statement that science has the answers to most of the unsolved problems in our society. About 23% of the students agreed with this statement while 21% were undecided about this issue.

-- Appropriateness of scientific methods in solving human problems: There was no prevailing student response to this question. Student responses were about equally distributed across response categories to the statement "The scientific way of solving problems can be used to solve the problems of human beings."

Comparisons of Student Attitudes from CAEP 1974-75 to CAEP 1979-80

Student responses to questionnaire items that were repeated from the previous assessment were very similar. (Refer to the Technical Report for questionnaire data from both assessment years.) However, response differences found in two items are worthy of mention here.

CLASSROOM ACTIVITIES, GRADE 4. When asked to select the classroom science activity in which they most often engaged, significantly more students in the present assessment (44%) selected reading than in the previous assessment (26%). By comparison, 14% fewer students reported actually working with science materials in 1979-80 than in 1974-75.

ABILITY OF SCIENCE TO SOLVE SOCIETAL PROBLEMS. The item which revealed the largest change in student attitude from CAEP 1974-75 to the present assessment involved student agreement with the statement that science has the answers to most of the unsolved problems in our society. In the 1974-75 assessment, approximately two-thirds of the students in Grade 11 agreed with this statement. By comparison, less than one-quarter of the eleventh-grade students in the present assessment agreed with this statement.

CHAPTER VII

INTERPRETATIONS AND RECOMMENDATIONS

Introduction

This section of the report contains an analysis and interpretation of the findings of the assessment and a set of recommendations based on the findings. The findings of this year's science assessment constitute descriptive information about the skills and knowledge of Connecticut students in Grades 4, 8, and 11. For this purpose, the tests were designed to address objectives believed to be important to the teaching of science. The items selected for the tests were appropriate to science as it is taught in Connecticut. However, the tests should not be seen as representing all of the science skills that students should develop in the course of their schooling.

The interpretations of the assessment findings are based upon professional expectations of student achievement, as well as on the performance data for items administered in the previous Connecticut and national assessments of science. Within this context, interpretive comments are made on performance which falls short of expectations and which meets or exceeds expectations.

While most recommendations are based on perceptions of weaknesses in student skills, student strengths should not be overlooked. In particular, areas which showed high performance by students should continue to receive attention in order to maintain strengths in these areas.

The narrative below summarizes the findings of the assessment. It is organized in terms of achievement by goal area and by total test, followed by results for the various reporting groups. The report concludes with a set of recommendations.

Goal I: Know the Fundamental Facts and Principles of Science

GRADE 4. Connecticut fourth-graders answered correctly an average of 69% of the items matched to this goal. This level of performance was slightly higher than the performance of students nationwide, and about the same as that of students in the Northeast. On items repeated from the 1974-75 Connecticut assessment, performance in the two years was about the same.

The examples below illustrate some of the items matched to Goal I and the corresponding performance levels of Connecticut fourth-graders.

-- More than nine out of ten students knew that a caterpillar would grow up to look like a butterfly (Item 1).

-- About 85% could identify which of four types of clouds would most likely bring rain on a summer day (Item 11).

-- About 60% knew that the sun is larger than the Earth, Mars, the Moon, or Venus (Item 8).

-- Fewer than half of the fourth-graders knew that "every seed contains a young plant, stored food, and a seed coat" (Item 3).

-- About 36% knew that "ideas" could not be considered "matter" (Item 25).

GRADE 8. At the eighth-grade level, Connecticut students answered about 63% of the Goal I items correctly. Their nationwide counterparts performed at about the same level, while the achievement level of students in the Northeast was slightly higher. Performance by Connecticut students in 1974-75 was also slightly higher than in 1979-80.

Some typical Goal I items and the percentages of eighth-graders who answered correctly are as follows.

-- About nine out of ten Connecticut eighth-graders knew that one of the functions of blood is to carry oxygen to different parts of the body (Item 4).

-- About three out of four students knew that fertilization takes place when a sperm enters an egg (Item 42).

-- About three out of five students identified "atoms" (rather than "compounds," "mixtures," or "protons") as the basic building blocks of matter (Item 46).

-- About 44% knew that the apparent bending of a spoon in a glass of water was due to refraction (Item 12).

-- About one-third of the Connecticut eighth-graders knew that most of the chemical energy of the gasoline burnt in a car is not used to move the car but is changed into heat (Item 55).

Connecticut students outperformed students in the nation on the items matched to knowledge of the fundamental facts of biological science (Objective 1), while they scored more poorly on items matched to the physical or earth sciences (Objectives 2 and 3). (See Recommendations 1 and 2 on page 58.) Furthermore, within the biology category, Connecticut eighth-graders tended to perform relatively better on items measuring knowledge of the animal kingdom rather than the plant kingdom. (See Recommendation 3 on page 58.)

One item (#20) asked students to identify the major cause of air pollution in most large American cities. Only 32% correctly chose the response "cars," while almost all remaining students chose the incorrect response "factories." This response reflects a common misconception concerning pollution.

GRADE 11. Connecticut eleventh-graders answered correctly about 56% of the items matched to Goal I at that grade level. This achievement level was about 3% below that of students nationwide, and about 6% below that of students in the Northeast. On the set of items repeated from the earlier Connecticut assessment of science, performance this year was about five percentage points lower.

Examples of items and performance levels are as follows.

-- Ninety-five percent of Connecticut eleventh-graders knew that one function of blood was to transport oxygen (Item 4).

-- About four out of five students knew that the particles that make up atoms are usually said to be protons, neutrons, and electrons (Item 15).

-- Slightly more than half knew that "uncontrolled cell division" was a good description of "cancer" (Item 11).

-- About 28% knew that it would take approximately eight minutes for a change on the surface of the Sun to be observed on Earth (Item 18).

-- About one out of five students knew that a television picture is caused by electrons (rather than atoms, x-rays, or light rays) striking the television screen (Item 73).

Comparisons of the performance of Connecticut students with that of students nationwide on this goal indicate that knowledge of the fundamental facts and principles of science represents the area of greatest need which must be addressed by Connecticut educators. As was the case with eighth-graders, Connecticut eleventh-grade students performed comparatively

better in the biological, rather than the physical or earth sciences. Comparisons of objective scores for CAEP vs. NAEP students shows that, while scores for the two groups are about the same for biology items, Connecticut students were outscored by students in the nation on both physical and earth science items by about five percentage points in each case. (See Recommendations 1 and 2 on page 58.)

Item 5 asked students to identify the simplest biological unit of structure. While 78% of the students chose the correct response, "the cell," the remaining 22% chose either "the organ," "the tissue," "the organism," "the population," or "I don't know." One of the items answered correctly by the smallest number of students was Item 66, which asked students to identify the medium which "carries sound to your ears from a radio or television receiver 15 feet away." Only 21% chose "molecules of air," the correct response. About half of the students chose "radio waves" with the remainder choosing "electric current," "polarized waves," or "I don't know." The performance on this item by students in the nation (35% correct), in the Northeast (45% correct), and the previous Connecticut assessment (28% correct) had been substantially better. Similar differences in performance were found in Item 21, an earth science item which required students to know that heat and pressure below the Earth's surface were responsible for the transformation of limestone to marble or of soft coal to hard coal. Only 50% of the Connecticut eleventh-graders answered this item correctly compared to 68% of students in the nation, 75% of the students in the Northeast, and 63% of Connecticut students in 1974-75.

Goal II: Apply the Fundamental Principles of Science

GRADE 4. Connecticut fourth-graders answered correctly an average of 52% of the Goal II items on the Grade 4 test. This level of achievement was slightly higher than that of students tested by NAEP throughout the nation and in the Northeast. Student performance this year was at about the same level as performance by Connecticut students in 1974-75.

Performance on some typical items matched to this goal at the fourth-grade level appear below.

- About 93% of Connecticut fourth-graders could recognize the most appropriate notational representation of a simple picture (Item 12).
- About 78% knew that when an animal breathes faster and its heart beats faster, the animal is most likely frightened (rather than cold, resting, or sleeping) (Item 16).
- Just under half of the Connecticut fourth-graders tested could accurately predict the appearance of the mirror-image of a word (Item 24).

-- About one-third knew that the reason light-colored clothes are cooler in summer is because they reflect more sunlight than dark-colored clothes (Item 14).

-- About one student in eight knew that if a glass of water was put in a freezer, the glass of ice would weigh the same as the glass of water (Item 34).

In Item 31, students were asked what the water temperature would be if equal amounts of water at 50° Celsius and 70° Celsius were mixed together. Only 10% chose 60° Celsius, the correct answer. About three-quarters of the students chose either "120° Celsius" or "I don't know." However, the averaging concept is a relatively difficult one for students in Grade 4. In Item 38, students were asked to predict the weight of the resulting mixture if one kilogram of salt were added to 20 kilograms of water. About half of the students chose the correct response, "21 kilograms." About 50% of the students could also correctly estimate the length of a pencil in centimeters (Item 40). While these performance levels may seem low, it should be noted that Connecticut students outperformed those in the nation and Northeast on all three of these items.

GRADE 8. At this grade level, students answered about 57% of the Goal II items correctly. Performance was comparable to that of the two NAEP comparison groups (nation and Northeast). On items repeated from the 1974-75 Connecticut assessment of science, performance declined by about six percentage points.

Representative items and the corresponding scores are as follows.

-- Approximately 88% of Connecticut eighth-graders knew that the best evidence that dinosaurs once lived comes from fossils (Item 41).

-- About seven out of ten students knew that much of the oxygen found in ocean water comes from plants living in the water (Item 36).

-- Half of the Connecticut eighth-graders could correctly compute the temperature of two liters of water made up of one liter at 50° Celsius and another at 70° Celsius (Item 31).

-- About one-third knew that the density of the human body is most nearly equal to the density of water (rather than of air, cork, hydrogen, or iron) (Item 16).

-- About one in five Connecticut eighth-graders knew that the burning of a candle produced molecules different from those present before burning (Item 15).

The performance of Connecticut eighth-graders on Item 38, which involved the conservation of matter (see the earlier discussion of this item for Grade 4), was substantially higher than the performance by students in the NAEP samples. Connecticut students were also more adept at differentiating fact from opinion (Item 52). However, students in the nation and Northeast outperformed Connecticut students on Item 59, which asked students to identify which of the following foods provided the most protein per serving: boiled potatoes, green beans, lean meat, oatmeal, or white bread. About 37% chose the correct answer (lean meat).

GRADE 11. Connecticut eleventh-graders answered correctly just under half of the Goal II items on their test instrument. This performance level was about the same as (i.e., within two percentage points of) performance in the nation and somewhat lower than performance by NAEP students in the Northeast. In 1979-80, Connecticut students scored about 5% lower than Connecticut students in 1974-75 on identical Goal II items.

The examples which follow typify the achievement on items at this grade level.

- -- Almost all eleventh-graders (96%) knew that in order to nutritionally balance a meal of milk, bread and butter, meat, and cake, a green or yellow vegetable should be added (Item 7).
- -- About 83% knew that insulin (rather than estrogen, iodine, penicillin, or thyroxine) is used in the treatment of diabetes (Item 10).
- -- About half knew that heat evolves from any combustion reaction (Item 72).
- -- About three out of ten students knew that large mineral crystals are probably formed when a mineral solidifies slowly from hot liquid (Item 24).
- -- About one out of five students could correctly choose the proper set of laboratory apparatus needed to obtain pure water from salt water (Item 13).

A number of the items matched to this goal were quite difficult for Connecticut students. For example, Item 64 required students to know that a wire connected to a direct-current source would not vibrate if placed near a magnet. Only 18% of the eleventh-graders answered this item correctly. One indication of its difficulty was that 36% of the students chose the "I don't know" response for this item.

Goal III: Understand and Apply the Processes of Science

GRADE 4. Connecticut fourth-graders answered 69% of the Goal III items on their test correctly. This achievement level was slightly higher than that of students nationwide and about the same as NAEP students in the Northeast. However, on the ten items repeated from the 1974-75 assessment, performance this year fell about six percentage points.

Representative scores and items are enumerated below.

- -- Ninety-two percent of the fourth-grade students could interpret a bar graph (Item 43).
- -- About three out of four fourth-graders could predict what a jar containing a mixture of pebbles, dirt, and water would look like after standing for a week (Item 21).
- -- About two-thirds knew that, in order to measure a boy's growth over the course of a year, it was necessary to know the boy's height at the start of the year (Item 17).
- -- About 44% knew that scientists would have the most trouble testing the statement "my dog is better than your dog," compared to such statements as "I have a fever" or "I can lift a 20-pound bar" (Item 29).
- -- About 37% correctly answered an item involving a line graph which required the students to realize that an increased rate of speed implies a decrease in the time required (Item 44).

GRADE 8. Eighth-grade students answered 67% of the Goal III items correctly. The performance on these items by students throughout the nation and Northeast was at about the same level. Connecticut students in the 1974-75 science assessment scored about three percentage points higher than students in 1979-80 on identical items administered in both years.

Some typical items and the corresponding performance by Connecticut eighth-graders appear below.

- -- Almost all eighth-graders (96%) could interpret a simple line graph (Item 44).
- -- About four out of five students could infer the purpose of an experiment based on a simple description of its procedure (Item 63).

-- About 63% could choose the correct statement to explain why pumping air out of a can would cause it to collapse (Item 18).

-- About half knew that "controlling all important variables" was essential when conducting an experiment (Item 51).

-- About one-quarter of all eighth-grade Connecticut students could predict how many weeds would grow in a meadow, given information about the ecological history of the meadow (Item 35).

GRADE 11. At the eleventh-grade level, students answered correctly about 64% of the Goal III items on their test. This level of performance was comparable to that of students in both NAEP comparison groups. It was also about the same level of performance as students in the previous Connecticut assessment on repeated items.

Examples of typical performance levels are as follows.

-- Almost all students (96%) recognized that an illustration of the sun shining on a plant showed energy being tranformed from one form to another (Item 58).

-- About three-quarters of all students could choose the set of data which gave the strongest evidence to support a hypothesis (Item 27).

-- About three-quarters also knew that "when scientists carefully measure any quantity many times, they expect that most of the measurements will be close but not exactly the same" (Item 49).

-- About half of the Connecticut eleventh-graders could correctly predict how many weeds would grow in a meadow, given its ecological history (Item 35).

-- About 30% knew that an iron container filled with hydrogen would weigh more than the same container after it had been evacuated (Item 40).

Goal III was the only goal in which the performance by eleventh-graders was about the same as the performance by students in the nation, the Northeast, and the previous assessment. It should be noted that student understanding of science applications and processes is stressed in the curriculum of most Connecticut schools. (See Recommendation 4 on page 58.)

Total Test

Some general comments may be made concerning the test which are not specific to any one goal. First, the decline in performance since the earlier Connecticut assessment could be due to a number of factors. There has been a consistent decline in student performance across all subject areas over the past decade. Such a decline was found for NAEP administrations of identical science items for the period from 1969-70 to 1976-77. Thus, administration of this year's Connecticut science test to a nationwide sample would most probably yield lower national scores than the ones used for comparison purposes in this report.

Secondly, resources available in recent years may well have had a direct influence on student performance. For science in particular, significant resources available in the 1960's from such sources as the National Science Foundation were unavailable in the 1970's. (See Recommendation 5 on page 59.)

As in the 1974-75 science assessment, the comparative performance of Connecticut students is better at the earlier grade levels. That is, Grade 4 students performed at a slightly higher level than their national counterparts, Grade 8 students at about the same level, and Grade 11 students at a slightly lower level.

Reporting Groups

SEX OF STUDENT. As in the previous assessment, males tended to outperform females at all grade levels. It should be noted that fewer girls than boys enroll in science courses, and that some textbooks, especially earlier texts, have tended to maintain sex stereotypes. (See Recommendation 6 on page 59.)

VALUATION OF SCIENCE. According to their responses on the student questionnaires, it appears that Connecticut students consider science valuable. About 88% of the students in Grade 4 thought science would make their lives better and approximately the same percentage of eighth- and eleventh-graders indicated that they felt the study of science was "valuable" or "very valuable." This positive attitude was also evident in the previous CAEP assessment.

In CAEP 1974-75, two-thirds of the eleventh-grade students agreed that "science has the answers to most of the unsolved problems in society," while less than one-fourth of the students in the present assessment agreed with this statement. In addition, students who disagreed with this statement outperformed the statewide average by 2 percentage points. This reversal in attitude regarding this statement may be interpreted as indicating a greater sophistication in today's students. While students appear to consider science valuable, they also recognize its limitations.

This increased sophistication was further reflected in the responses of students to question 25 ("the scientist is willing to let people test or question what s/he believes to be true") and 26 ("science helps us to control the forces of nature"). Student agreement to these statements was 5 to 12 percentage points below student agreement to these statements in 1974-75. Current scientific issues such as the energy crisis, pollution, and the Three Mile Island incident may well be some of the factors contributing to public skepticism of science reflected here in student attitude responses.

ATTITUDE TOWARD SCIENCE. Student attitudes toward science were generally favorable. About 60% of the fourth-graders, 70% of the eighth-graders, and 45% of the eleventh-graders reported that science was either "one of their favorites" or their "favorite" subject. Student attitudes appear to have become slightly more favorable compared to the previous CAEP assessment. In Grades 8 and 11, the number of students who reported that science was either "one of their favorites" or their "favorite" subject increased by from 4 to 5 percentage points since 1974-75.

Students who liked science tended to outperform the statewide average by as much as 12 percentage points (at Grade 11), while achievement of students who disliked science averaged below the statewide score by as much as 10 percentage points (Grade 11). The activities most liked and disliked are further outlined below.

CLASSROOM SCIENCE ACTIVITIES.

-- Reading about science: It may be hypothesized that a process or non-text approach to the teaching of science was probably more popular at the time of the previous assessment. More science programs now are relying on more standard text materials. This hypothesis is supported at the fourth-grade level since almost twice as many students this year (44%) as five years ago (26%) reported that their most frequent science activity is reading about science (as opposed to doing experiments, writing about

science, listening to the teacher talk about science, or talking to other children about science). Although students' like or dislike of reading bore no relationship to student achievement in science, this activity was the least popular with students in Grade 11.

-- Classroom discussions about science: Students who liked class discussion tended to outperform the statewide average, and the performance of students who disliked class discussion was from 5 to 7 percentage points below the statewide average.

-- Actually doing laboratory experiments: This activity appeared to be the most popular science activity at all three grade levels. A substantial majority of students (85% in Grade 4, 77% in Grade 8, and 57% in Grade 11) reported that they enjoyed performing laboratory experiments. In addition, performance scores for students who reported enjoying this activity were above the statewide average by 1 to 2 percentage points. (See Recommendation 7 on page 59.)

-- Time spent on science: Achievement was lower when less time was spent on science (Grade 4) or on actual participation in science activities (Grades 8 and 11). Students at each grade level who reported "never" spending time on science averaged at least 6 percentage points below the statewide average. This question referred (for Grades 8 and 11) to the amount of laboratory time students actually spent engaging in and manipulating materials for science activities. Students who engaged in experiments and/or enjoyed experiments tended to perform above the statewide average.

-- Science course electives, Grade 11: A number of questionnaire items dealt with students' previous and present enrollment in specific science courses. The most popular science course was biology, which 88% of the students reported they had taken. Student enrollment in general science was down slightly from the previous assessment (about 3 percentage points). Students who reported never having taken a general science course outperformed the state (by 2 percentage points) while scores of students who had taken general science scored below the statewide average. This is probably because students who have not taken general science are more likely to be college-bound and enrolled in a specific science course such as biology or chemistry. These latter courses are more likely to offer laboratory periods and

other resource material not afforded those enrolled in general science. The subject matter included on the test is less likely to be covered in general science courses than in other science courses. In addition, students considered to be in the lower ability groups more often enroll in general science, and the texts used in general science courses are more likely to be outdated than those used in more advanced courses. (See Recommendation 8 on page 59.)

EXTRA-CURRICULAR SCIENCE ACTIVITIES. Students in Grades 8 and 11 who indicated they had a science hobby outperformed the statewide average by 2 to 4 percentage points. In addition, one of the better discriminators of student achievement was student enjoyment in watching a television show about science or visiting a museum. Students who enjoyed these activities averaged 2 (Grade 4) to 5 (Grade 8) to 8 (Grade 11) percentage points above the statewide average, while average achievement of students who did not enjoy these activities was below the state by 4 to 9 percentage points. (See Recommendation 8 on page 59.)

Recommendations

The recommendations presented below were made after extensive discussions, analysis, and interpretation of the assessment results. It is hoped that the implementation of these recommendations will serve to improve the quality of science education in Connecticut. The recommendations are appropriate to several audiences, including teachers, local administrators, curriculum planners, and state-level decision-makers.

1. The relatively poor performance by students on physical and earth science items indicates that more emphasis should be given at the elementary level to those subject areas. Students at the secondary level should enroll in a minimum of two years of science courses--one year of biology and one year of the physical and/or earth sciences.

2. Earth science should be recognized as being as important as the other sciences. All students enrolled in earth science courses should have the opportunity to do laboratory work.

3. Connecticut students should receive instruction in botany as well as zoology as part of their biological science course. Laboratory experiences in botany should also be offered.

4. Classroom teachers and district personnel should continue to stress the scientific processes (such as observation, classification, etc.) in the instruction of science.

5. The rapidly changing nature of scientific information and technology requires the maintenance of current and up-to-date instructional materials.

6. Girls should be encouraged to enroll in science courses and to participate actively in the laboratory. Special care should be taken to select curriculum materials which avoid sex role stereotyping.

7. Laboratory activities have been shown to be important for increasing the understanding of science. Laboratory time should be available for all science courses in order to encourage classroom discussion, laboratory experience, and student interest in these courses. Sufficient time at the secondary level should be allotted to laboratory periods to allow for preparation and actual experimentation.

8. At the secondary level, more instructional time should be allocated to the teaching of science for those students who are not college-bound. Students of lesser academic ability must be given access to instructional materials and laboratory time which are equivalent in quality and recency to those offered to other students.

9. Student participation in extracurricular science activities should be encouraged and acknowledged, and students should be urged to share their science experiences.

10. It is important that secondary school science teachers and teaching assignments be well matched. Teachers should be assigned only to those subject areas in which they have had recent training or experience. Continued in-service activities are essential to provide up-to-date content and methods of instruction.

11. Local districts should strongly support in-service training programs. Teachers should be encouraged to continuously update their teaching skills and content area knowledge. Institutions of higher education are urged to become more responsive to the needs of area schools and teachers in offering content and methods courses.

12. Qualified science coordinators/supervisors should be available to assist teachers in the teaching of science. There should be supervision and evaluation directed toward program enrichment and improvement of teaching skills.

13. Adequate resources must be made available for the teaching of science. Appropriate instructional materials, laboratory supplies, capital equipment, and laboratory facilities to assure the safety of all science students must be available. Care should be taken to guard against oversized classroom assignments which require teaching to become supervisory rather than instructional in nature.

14. The state should provide a high degree of leadership in assisting local districts to develop science curricula and staff development activities. Given the decrease in the number of science coordinators at the local level, it has become increasingly important that the state assume and maintain a more active role.

APPENDIX A

ITEM RESULTS BY REPORTING GROUP

ITEM RESULTS BY REPORTING GROUP

This appendix contains tables displaying the results for each item administered to students at each level.

The following information for each test item is presented:

- the number of the test question as it appeared in the test booklet
- a specification of the item task
- the percentage of all students answering correctly as well as the percentage in each of the Connecticut reporting groups defined by the variables: sex of student, size of community, and region; where the question was also tested by NAEP, the percentage of all students in the nation answering correctly; and where the question was also tested in the CAEP 1974-75 assessment, the percentage of all Connecticut students answering correctly.

Tables 5, 6, and 7 present this information for fourth-, eighth-, and eleventh-graders, respectively.

TABLE 5

Test Item Performance of Fourth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
	GOAL 1																
1	The caterpillar will grow up to look like which of the pictures?	95	94	95	89	95	95	96	99	94	95	97	94	95	96	93	--
2	Which of these trees stays green in the United States all winter?	81	82	81	56	85	84	87	87	82	88	82	87	89	86	83	88
3	Which of the following statements is true about seeds?	45	45	46	27	44	47	52	48	46	50	45	52	45	48	50	--
4	Which of these plants does not have green leaves?	74	71	77	66	73	75	78	78	75	74	75	76	79	76	80	83
6	Our Sun is a:	68	73	63	46	69	69	74	78	69	69	69	76	66	71	55	62
8	Which of the following is the largest body?	60	67	54	44	58	62	66	68	57	63	60	62	71	63	60	--
9	Each year the Earth moves once around:	72	77	67	56	71	70	80	76	63	75	76	81	75	74	74	75
11	On a summer day which cloud is most likely to bring rain?	85	85	85	71	87	86	89	88	82	89	90	87	86	87	89	89
25	All of the following can be called matter except:	36	39	33	30	40	36	36	44	38	36	33	39	34	37	39	34
26	Iron is most likely to rust when it is:	77	79	76	50	80	80	83	80	82	82	81	84	79	81	66	75
	GOAL 2																
5	Which pictured seed would be most likely to stick to an animal?	62	63	61	50	64	61	65	64	68	63	59	65	66	64	62	--
7	One reason there is a day and night on Earth is that the:	84	88	81	66	86	86	88	90	82	87	88	88	84	87	83	78
12	Using D for Duck and C for Cat, which best represents the picture?	93	91	94	82	95	94	94	97	95	94	94	95	91	94	90	92

Results for Regions do not include Big City students. "All" refers to the scores of all students except for those who reside in Big Cities.

TABLE 5

Test Item Performance of Fourth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																	
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
13	What is the main way sweating helps your body?	18	20	16	14	22	14	20	27	24	14	15	19	16	18	18	--
14	Why is it cooler to wear light-colored clothes in the summer?	32	35	30	16	34	33	37	39	28	40	30	36	32	35	31	--
15	Evaporation takes place in all of the following except:	22	24	20	16	22	24	23	30	23	23	19	24	20	23	24	33
16	When an animal breathes faster and its heart beats faster, the animal is most likely:	78	76	80	66	80	78	83	80	81	82	78	79	81	80	70	--
18	Which row of pictures shows best the way a plant grows?	85	87	84	68	88	85	90	88	87	88	87	93	84	88	87	--
19	A baby chick grows inside an egg for 21 days. Where does the chick get its food before it hatches?	38	42	36	31	40	39	40	34	42	39	38	47	37	40	46	--
24	A mirror image of the word popsicle would look like which of the following?	48	45	50	34	49	49	51	50	51	52	45	51	48	50	41	--
27	A different substance is formed when:	46	52	41	22	50	49	51	63	49	48	43	54	51	50	49	51
28	What can scientists learn by studying some fossils?	70	75	67	46	74	73	76	80	75	69	77	80	64	74	67	66
30	Which would be easiest to measure with a 12-inch ruler?	76	77	76	58	79	77	82	82	76	82	78	81	75	79	70	78
31	A liter of water (temp. 50°C.) is mixed with a liter of water (temp. 70°C.). The water temperature after mixing will be about:	10	10	10	8	11	9	11	13	8	11	10	9	12	10	6	--
34	A glass of water is weighed and then frozen. What would be found if the glass was weighed again after it froze?	12	13	11	15	12	12	11	12	12	11	11	14	12	12	13	--
35	Why are the rocks and pebbles in river beds usually smooth?	42	42	42	19	46	38	50	44	52	42	45	52	35	45	45	--

TABLE 5

Test Item Performance of Fourth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly															NAEP	CAEP 1974-1975
		All	Sex		Size of Community				Region*									
			M	F	1	2	3	4	1	2	3	4	5	6	All*			
37	Which is most likely to make a rock break open?	59	61	58	36	63	61	66	66	61	64	66	61	57	63	52	--
38	One kilogram of salt is dissolved in twenty kilograms of water. The resulting saltwater will weigh:	51	54	48	37	51	51	56	55	49	55	50	59	51	53	39	--
40	About how long is this pencil?	50	55	47	32	56	47	56	56	58	57	44	49	56	53	40	--
41	What is the best evidence that dinosaurs once lived?	64	69	60	36	70	69	69	75	72	67	69	67	58	69	60	--
	GOAL 3																	
10	High clouds are above 20,000 feet, middle clouds between 6,000 and 20,000 feet, and low clouds from 0 to 6,000 feet. A cloud at 10,000 feet is:	73	73	73	57	77	74	76	77	75	79	72	76	62	75	59	72
17	If you want to find out how much a boy grew in a year, what must you know about the boy?	67	65	69	40	70	74	71	71	70	74	71	68	66	71	66	76
20	Which is the best way of testing whether a mixture of salt and sugar with water would make salt-water taffy?	61	58	64	40	64	61	68	71	66	66	60	63	60	64	69	77
21	Which would a shaken mixture of water, pebbles, and dirt look like, given a week to settle?	73	74	73	61	74	73	79	77	75	78	72	76	73	75	72	--
22	A rock placed in 5 liters of water raised the water to the 6 liter level. The space taken up by the rock is:	71	74	69	49	74	72	77	77	74	76	72	77	74	75	63	74
23	Which shows an X in the same place as the dog in the picture?	78	77	79	65	80	79	81	82	79	80	81	80	76	80	83	86
29	Scientists would have trouble testing which of the following?	44	46	43	19	51	43	51	53	47	47	47	52	50	48	39	47

TABLE 5

Test Item Performance of Fourth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																	
		All	Sex		Size of Community				Region*								NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*			
32	This chart of breathing rates of people at rest suggests that:	74	74	75	55	77	75	80	81	75	79	75	77	76	77		67	71
33	When Block 1 swings down and hits Block 2 at rest, what will most likely happen?	73	74	72	51	78	72	77	77	78	78	72	75	75	76		69	--
36	After a day, which container will have the least amount of water?	65	68	63	47	67	66	70	70	63	70	68	69	65	68		62	74
39	This graph shows the weight of four boys. What does Bill weigh?	91	90	93	82	92	92	95	93	91	95	92	94	91	93		90	--
42	From the chart, which chemical elements are found in the smallest amount in the body?	57	56	57	36	60	56	63	64	63	62	57	60	49	60		56	70
43	According to the graph, your heart beats fastest when you are:	92	92	93	86	92	94	94	95	93	93	92	95	94	93		91	95
44	From the graph, which day did Blast O'Wind run the fastest?	37	37	36	44	37	34	35	41	36	32	37	33	34	35		47	--
45	From the graph, fill in the no. of seconds missing in the table.	76	75	78	61	78	76	81	78	77	82	77	81	70	78		69	--

TABLE 6

Test Item Performance of Eighth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
	GOAL 1 - OBJECTIVE 1																
1	Is it a function of the blood to protect against disease?	69	71	67	61	72	72	68	68	70	69	72	74	70	70	70	--
2	Is it a function of the blood to carry waste materials from the cells?	70	69	71	67	67	75	69	68	75	66	70	76	67	70	60	--
3	Is it a function of the blood to digest food?	80	83	77	67	82	84	83	82	79	85	83	84	74	82	74	--
4	Is it a function of the blood to carry oxygen to different parts of the body?	90	92	88	85	89	91	91	93	92	88	88	95	91	91	79	--
5	When a person sees something, what carries the message from the eyes to the brain?	81	84	79	69	82	84	85	84	82	81	85	87	89	84	78	78
6	What is the most important thing that the lungs do?	84	88	81	73	85	86	87	86	88	87	83	88	84	86	84	91
42	Fertilization takes place when a sperm:	77	77	76	54	84	78	81	74	83	84	78	82	79	81	65	--
60	Seeds come from which part of the plant?	66	66	66	43	67	68	74	70	69	69	70	71	82	71	68	72
61	Green plants make sugar by the process called:	57	61	53	35	55	61	64	74	60	57	59	58	66	61	62	58
62	Green plants are important to animals because the plants:	46	50	43	27	50	48	51	51	51	52	47	47	51	50	53	57
64	A parasite is an organism that:	40	42	39	24	40	40	48	45	44	40	45	46	42	43	51	--

Results for Regions do not include Big City students. "All" refers to the scores of all students except for those who reside in Big Cities.

TABLE 6

Test Item Performance of Eighth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
	GOAL 1 - OBJECTIVE 2																
12	A spoon in a glass of water appears to bend sharply. This apparent bending is due to:	44	52	38	35	49	46	43	47	49	42	48	45	50	46	51	46
46	From which of these can all kinds of matter be formed?	60	65	56	47	62	64	62	59	66	64	62	61	65	63	55	47
47	Atoms of all the elements have:	36	38	34	22	39	37	38	43	40	35	36	39	44	38	35	39
55	Most of the chemical energy of gasoline burned in a car is not used to move the car but is change into:	35	40	31	38	36	34	34	34	33	35	36	35	40	35	48	43
	GOAL 1 - OBJECTIVE 3																
7	About how long would it take a rocket ship to reach the moon?	55	67	46	44	60	58	56	57	60	57	62	51	52	58	76	--
8	Which of the following is the largest body?	77	84	70	61	78	82	79	84	81	77	80	80	80	80	77	--
9	Each year the Earth moves once around:	85	89	81	74	86	87	8[illegible]	86	89	87	86	84	88	87	[illegible]	--
10	The time it takes for the Moon to go from new to full and back to new is about:	45	48	42	28	46	47	50	48	47	49	45	48	52	48	50	55
11	On a summer day, which of the following clouds is most likely to bring rain?	91	93	89	83	92	92	92	90	91	92	91	94	95	9[illegible]	93	95
20	What is the major cause of air pollution in most American cities?	32	37	27	22	31	32	36	31	29	36	31	36	40	33	30	--
53	Which of these helps account for the fact that a compass can be used to find north on Earth?	57	67	48	33	64	58	63	63	63	58	64	61	69	62	58	60

TABLE 6

Test Item Performance of Eighth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
	GOAL 2 - OBJECTIVE 4																
13	Water is heated as shown. If the stopper pops out what is most important in accounting for this?	53	62	46	48	55	53	54	52	52	57	51	57	55	54	56	55
14	Why is it cooler to wear light colored clothes in the summer?	74	79	69	43	80	77	80	85	80	76	80	79	78	79	75	--
15	Which of the following most clearly forms molecules different from those present at the start?	20	22	19	18	20	21	20	23	21	22	20	15	22	20	27	31
16	The density of the human body is most nearly equal to that of:	32	36	28	21	33	34	33	33	31	34	29	40	41	34	33	40
17	A block of wood floats, two-thirds submerged in fresh water. If it were placed in salt water what would probably happen?	39	45	35	31	41	39	42	40	40	38	46	43	40	41	39	44
22	Which of the following would least upset the balance of animal and plant life in a small area?	64	69	60	38	68	67	72	71	71	71	66	68	64	69	57	72
23	Which best describes the results of milk pasteurization?	27	27	28	13	29	31	29	32	30	29	28	30	34	30	41	37
24	A mirror image of the word popsicle would look like which of the following?	71	69	73	61	71	74	73	71	73	73	72	75	76	73	62	--
25	To get the salt out of saltwater one could:	67	72	63	53	70	68	70	69	70	66	71	69	74	69	73	69
26	If all green plants died, what would be the most important effect on man?	44	48	40	28	44	47	48	53	46	42	50	42	57	47	41	50
30	Which is true of hot water as compared with cold water?	56	60	53	41	61	56	60	65	59	59	61	51	60	59	61	68

TABLE 6

Test Item Performance of Eighth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly															NAEP	CAEP 1974-1975
		All	Sex		Size of Community				Region*									
			M	F	1	2	3	4	1	2	3	4	5	6	All*			
31	A liter of water at a temp. of 50°C. is mixed with a liter at 70°C. Water temp. just after mixing will be about:	50	56	44	23	56	51	55	53	61	54	52	53	51	54	46	--
33	In order to balance the beam pictured, you should hang a 2 lb. weight on the left side at position:	63	69	58	49	68	62	67	70	69	67	57	67	65	66	55	60
36	Where does much of the oxygen that fish and other animals take from the ocean water come from?	70	75	66	60	71	71	74	68	74	72	71	73	74	72	74	--
37	Which one of the following is most likely to break a rock open?	75	78	72	55	79	75	80	84	79	78	73	79	83	78	76	--
38	One kilogram of salt is dissolved in twenty kilograms of water. The resulting saltwater will weigh:	56	62	51	56	56	56	57	61	55	54	56	58	54	56	37	--
39	The statement that the relative humidity is 50% means that:	27	27	26	15	27	28	31	29	29	31	25	27	27	28	30	--
40	About how long is the pencil shown in the drawing?	73	78	69	46	77	76	81	75	79	79	74	82	77	78	61	--
41	What is the best evidence that dinosaurs once lived?	88	89	87	68	90	90	94	92	93	92	90	91	92	92	84	--
43	What is needed to move cars, heat hamburgers, and light rooms?	88	88	87	81	89	88	90	88	89	90	88	89	91	89	93	93
52	Which statement is an opinion rather than a fact about cats?	79	77	81	57	83	82	84	82	87	83	81	83	81	83	71	84
59	An average serving of what food would provide the most protein for building and repairing body tissue?	37	40	35	26	38	41	40	32	42	39	36	44	50	40	55	44

TABLE 6

Test Item Performance of Eighth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly															NAEP	CAEP 1974-1975
		All	Sex		Size of Community				Region*									
			M	F	1	2	3	4	1	2	3	4	5	6	All*			
	GOAL 3 - OBJECTIVE 5																	
27	According to the chart, in what month should the dog's daily food allowance have been increased to four cups?	63	65	61	50	66	63	67	65	64	66	68	63	63	65	61	64
28	If 30 students measured a playground which would probably be closest to its actual length?	54	58	50	31	58	55	61	52	63	61	54	58	55	58	45	--
44	According to the graph, the highest temp. was recorded on:	96	96	96	86	98	98	98	97	98	97	98	99	98	98	94	--
56	Does the picture (burning light bulb) show energy being changed?	72	74	71	71	75	71	72	73	74	73	73	67	73	72	76	--
57	Does the picture (chair) show energy being changed?	94	93	94	90	95	93	95	93	95	96	92	95	94	94	92	--
58	Does the picture (sun heating plant) show energy being changed?	90	90	90	89	91	90	90	90	91	92	89	87	93	90	83	--
	GOAL 3 - OBJECTIVE 6																	
18	Air is pumped out of a can and it collapses. Which best explains why?	63	66	60	44	63	68	67	72	64	66	64	67	67	66	66	--
19	A qt. of water at room temp. is poured into five containers. When heated to 150°F. the highest water level is in:	55	62	49	40	58	55	60	59	58	59	53	58	60	58	51	60
21	Which is the most likely cause for paint to last longer on one side of a house than another?	85	85	85	72	88	86	89	88	87	88	88	89	87	88	83	88
29	Scientists would have trouble testing which of the following?	77	77	77	58	81	80	81	81	81	81	78	84	84	81	73	81

TABLE 6

Test Item Performance of Eighth-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																	
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
32	Which picture shows the circuit that will light the bulb when the switch is closed?	75	83	68	66	82	73	76	76	79	79	74	75	78	77	68	--
34	A glass of water is weighed then frozen. Which describes its new weight?	30	33	26	23	35	26	32	34	32	31	30	28	31	31	29	--
35	A meadow with a yearly growth of 100 weeds produces 1,000,000 seeds. How many weeds will the meadow probably have next year?	25	31	20	15	28	23	29	26	27	27	26	28	29	27	28	--
45	A powder that is made up of both white and black specks is:	70	69	71	57	74	71	72	73	73	73	71	72	73	72	70	--
54	Why isn't more use of electric power a solution to coal, gas, and oil shortages?	48	52	45	36	48	50	54	50	54	49	46	53	57	51	48	--
65	Which object would you use to examine very small living things in a drop of water?	95	96	94	83	96	95	98	96	96	97	97	97	97	97	95	--
	GOAL 3 - OBJECTIVE 7																
48	What is a scientific theory?	61	59	63	44	64	63	64	60	64	66	66	61	62	64	56	64
49	When scientists measure a quantity several times, they expect:	58	54	62	42	59	61	63	60	63	62	57	63	65	61	69	69
50	To determine the average height of 13-year-olds, it would be most important to have a large number of:	74	74	73	52	78	76	79	74	79	77	79	79	77	78	68	72
51	Which of the following is essential in an experiment?	52	54	50	34	56	53	57	54	59	60	49	53	52	55	48	--
63	Joan had three bean plants one inch high, and put one in a dark closet, one in a window, and one under a light bulb. Why?	79	75	82	63	82	80	83	83	83	84	79	80	81	82	88	--

TABLE 7

Test Item Performance of Eleventh-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																	
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
	GOAL 1 - OBJECTIVE 1																
1	Is it a function of the blood to protect against disease?	80	79	81	72	83	78	84	80	82	83	81	78	83	81	84	--
2	Is it a function of the blood to carry waste materials from cells?	78	77	79	73	78	78	81	79	81	79	77	79	87	79	69	--
3	Is it a function of the blood to digest food?	83	84	81	75	85	81	86	82	81	85	84	86	83	84	82	--
4	Is it a function of the blood to carry oxygen to body parts?	95	96	95	89	96	96	98	95	96	96	96	98	98	96	92	--
5	What is considered the simplest biological unit of structure?	78	81	75	69	83	77	78	76	83	80	79	75	76	79	83	--
6	What is the placenta's function in a pregnant human female?	41	36	44	41	41	38	43	43	43	41	34	42	43	40	41	39
8	Which animal is a vertebrate?	67	69	64	54	70	68	68	67	72	68	67	70	69	69	71	76
9	When a plant stem cell divides each new cell has:	56	60	53	47	57	55	59	55	56	58	60	58	56	57	54	--
11	Cancer is best described as:	54	56	52	40	63	49	57	66	58	52	59	51	54	56	57	62
68	Natural selection is associated with whose theory of evolution?	65	64	66	45	72	61	72	72	66	73	62	62	73	68	66	72
	GOAL 1 - OBJECTIVE 2																
12	In hot climates white buildings more effectively:	62	70	55	51	64	63	63	68	66	62	63	62	58	64	64	65
15	The particles that make up atoms are:	81	82	79	68	80	86	82	81	85	83	81	82	81	82	77	89
16	Solid, liquid, and gaseous states of water differ in:	58	63	52	46	56	64	58	53	61	62	56	61	52	59	64	62

Results for Regions do not include Big City students. "All" refers to the scores of all students except for those who reside in Big Cities.

TABLE 7

Test Item Performance of Eleventh-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	#	1	2	3	4	5	6	All*		
17	The particles most directly involved in chemical bonds are:	55	55	54	44	56	55	58	56	60	53	54	64	52	56	51	47
22	An air-filled balloon taken from earth to the moon has the same:	34	42	26	24	34	36	35	33	37	39	29	33	39	35	30	30
62	The longer a 5 lb. rock falls off a 500 ft. cliff, the greater its:	47	43	50	49	46	45	47	52	49	41	46	48	48	46	55	45
63	What device changes the voltage of an electric power supply?	47	58	37	33	49	50	48	50	49	52	46	46	52	49	47	57
66	What carries sound to your ears from a receiver 15 ft. away?	21	30	12	16	18	24	21	23	22	22	20	17	27	21	35	28
67	Electric current in a copper wire involves mainly the movement of:	45	54	37	33	48	46	46	45	47	50	44	46	45	47	65	59
73	The picture on a television screen results from:	21	28	15	19	20	24	22	19	21	23	22	22	22	22	31	--
74	Which of the following can be detected with unaided human eyes?	57	65	50	46	58	56	62	58	59	60	54	62	62	59	59	64
	GOAL 1 - OBJECTIVE 3																
18	If the Sun's surface changed, it could first be observed on Earth in:	28	39	17	16	28	30	30	24	30	34	24	32	26	29	28	30
20	What is the major cause of air pollution in most American cities?	44	54	36	37	45	45	46	42	45	48	43	46	42	45	39	--
21	A change like limestone to marble or soft to hard coal is caused by:	50	60	41	42	51	52	51	55	51	54	46	51	45	51	68	63
23	Which describes how the Earth's surface changed over a billion years?	47	51	44	35	49	46	51	50	46	52	43	50	58	49	53	--
37	A star is most like:	56	69	43	48	55	57	57	57	58	56	59	54	56	57	53	--
75	Any galaxy contains many:	53	60	47	48	55	55	53	53	55	55	53	53	54	54	68	69

TABLE 7

Test Item Performance of Eleventh-Graders

Item #	Description of Item	Percentage of Students Answering Correctly															NAEP	CAEP 1974-1975
		All	Sex		Size of Community				Region*									
			M	F	1	2	3	4	1	2	3	4	5	6	All*			
	GOAL 2 - OBJECTIVE 4																	
7	What should be added to a meal of milk, bread and butter, meat, cake?	96	95	97	91	97	97	97	97	98	97	98	96	95	97		97	97
10	Which is used in treatment of diabetes?	83	82	85	70	85	84	88	90	81	87	83	88	85	86		80	89
13	Which apparatus is most useful in changing salt water to pure water?	20	28	12	17	18	22	20	22	22	20	17	20	21	20		21	26
14	Of two light waves in a vacuum the one with higher frequency will have:	29	31	26	22	31	28	30	30	32	30	28	28	27	29		30	27
19	Looking west you see a full moon near the horizon. What time is it?	37	43	31	26	37	39	39	40	45	38	34	34	36	38		35	--
24	Geologists believe that mineral samples with large crystals probably:	30	31	29	27	30	32	29	28	31	33	27	32	24	30		25	--
25	The time it takes for a pendulum to make one complete swing depends on:	44	52	37	33	45	48	45	44	53	45	44	45	44	46		51	54
26	Adding table salt to water results in the water's:	39	49	31	28	40	41	42	42	46	42	36	37	42	41		35	46
29	Two liters of water (40°C.) are mixed with one liter (100°C.), temp. just after mixing will be about:	58	61	56	51	60	58	59	55	57	64	54	61	62	59		57	65
30	Will coating a nail with oil help keep it from rusting?	67	80	54	64	64	68	68	69	67	70	60	65	70	67		64	--
31	Will painting a nail help keep it from rusting?	57	68	47	46	60	58	60	65	61	60	52	61	60	59		62	--
32	Will wrapping a nail in a wet towel help keep it from rusting?	95	96	95	92	96	94	97	95	95	97	95	97	95	96		97	--
33	Will dipping a nail in vinegar help keep it from rusting?	53	60	46	50	49	55	54	50	47	57	51	57	54	53		47	--

TABLE 7

Test Item Performance of Eleventh-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																	
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
34	Will putting a nail in a dry place help keep it from rusting?	69	69	69	61	69	70	72	70	70	71	69	71	73	70	75	--
36	Where does the oxygen that fish take from ocean water come from?	79	81	78	67	82	80	82	79	82	83	78	83	82	81	87	--
38	One kilogram of salt is dissolved in 20 kilograms of water. Water now weighs:	49	60	39	51	51	47	49	49	51	48	50	47	44	49	45	--
39	The statement that relative humidity is 50% means that:	41	45	37	33	40	42	42	42	46	41	39	43	36	42	44	--
42	Iron combines with oxygen to form rust; one should find that rust:	20	23	18	19	20	19	22	18	21	19	20	23	25	20	22	--
43	Nearly all gasoline now comes from:	91	94	88	80	93	90	94	94	94	91	90	94	89	92	92	93
44	If an uncharged metal plate gains electrons, the plate will:	44	49	40	34	47	45	45	45	51	45	44	42	42	46	37	--
52	In guinea pigs, black fur is dominant over white and dependent on one pair of genes. A crossing of white and black would result in:	36	33	39	25	37	37	39	35	37	36	41	38	41	38	37	39
54	For most chemical changes which most nearly described what occurs?	41	48	34	39	43	37	44	42	41	41	38	44	45	41	52	49
55	The equation $(2\ NO + O_2) = (2\ NO_2)$ is in dynamic equilibrium at a certain temperature. This means that:	30	31	29	31	29	27	32	33	39	27	22	32	28	30	28	--
60	An object starts at rest and moves with constant acceleration. If it moves at 10 meters per second after 5 seconds its acceleration:	27	31	23	19	28	26	29	31	29	30	22	25	31	28	23	24
61	A boat that can go 5 mph on still water moves with a 5 mph current. How long will a 10 mile trip take?	45	58	33	33	47	45	48	43	43	51	45	46	48	47	52	54
64	A copper wire with an alternating current is placed near the north pole of a magnet and vibrates. It would not vibrate if:	18	24	13	19	20	19	16	18	20	20	15	15	20	18	24	22

TABLE 7

Test Item Performance of Eleventh-Graders

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		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
65	The purpose of a fuse in an electric circuit is to:	42	60	26	33	45	46	41	47	45	47	40	35	48	44	49	45
69	How does the theory of natural selection explain the long necks of giraffes?	47	47	47	36	45	47	54	43	52	52	43	49	51	49	56	58
71	One example of oxidation is the:	47	49	45	39	45	49	50	57	46	42	40	52	53	48	56	58
72	Which happens when a combustion reaction takes place?	50	60	41	37	50	49	56	60	51	53	45	54	52	52	56	--
	GOAL 3 - OBJECTIVE 5																
27	In five experiments two objects were weighed four times. Which shows best that object 1 weighs more than object 2?	77	78	75	64	79	80	78	79	77	79	78	83	79	79	80	80
28	Thirty students measure the length of a playground. Which will probably be closest to the actual length?	71	76	67	52	73	73	76	68	77	77	72	78	72	74	73	--
40	An iron container is evacuated and weighed, filled with hydrogen gas and weighed again. The container's weight will now be:	30	37	23	24	32	30	30	32	33	32	26	29	34	31	34	--
45	Two identical spring balances are arranged as shown (springs with weight on A side). Which reading will be highest?	77	85	71	64	77	81	81	79	78	81	77	82	82	80	75	76
46	From the diagram, choose the best description of temperature to pressure ratio.	87	84	89	75	88	87	90	89	88	89	87	89	88	89	85	--
47	Which statement is supported by the data shown in the table?	69	72	66	52	71	69	74	70	72	71	72	71	72	71	61	--
50	Which graph best shows the temperature of the black soil and water?	41	45	37	28	40	43	44	46	37	48	38	44	42	43	32	--

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Test Item Performance of Eleventh-Graders

Item #	Description of Item	Percentage of Students Answering Correctly																
		All	Sex		Size of Community				Region*							NAEP	CAEP 1974-1975
			M	F	1	2	3	4	1	2	3	4	5	6	All*		
56	Does this picture (burning light bulb) show energy being changed?	86	88	85	80	86	87	88	91	85	88	86	86	90	87	87	--
57	Does this picture (chair) show energy being changed?	94	95	94	91	95	95	95	96	96	95	93	93	92	95	97	--
58	Does this picture (sun heating plant) show energy being changed?	96	95	96	91	96	95	97	97	98	95	95	96	95	96	89	--
70	According to the diagram, what kind of trait is brown fur in guinea pigs?	68	67	70	52	71	67	75	78	72	68	67	75	77	71	72	--
	GOAL 3 - OBJECTIVE 6																
35	A meadow with a yearly growth of 100 weeds produces 1,000,000 seeds. How many weeds will the meadow probably have next year?	49	55	43	34	52	47	54	48	54	51	47	53	55	51	54	--
48	Corn is planted in a flask and weighed every day for 3 weeks, showing a daily weight loss. Which is the best explanation?	15	17	14	14	18	14	15	18	17	16	14	15	12	16	18	18
53	Rabbits eat grass and are preyed on by hawks. If disease killed a large number of rabbits what would most likely occur?	71	75	68	53	72	71	79	71	75	74	73	78	80	74	66	74
59	On a level friction-free surface Ball A strikes Ball B while travelling at 10 meters per second. What happens to Ball A?	35	43	27	26	38	38	33	33	40	36	33	38	34	36	31	--
	GOAL 3 - OBJECTIVE 7																
41	A piece of hot iron is put into insulated cold water. What is not needed to determine how much heat the water has gained?	50	54	45	37	51	51	52	52	53	53	46	57	43	51	50	--
49	Whenever scientists measure a quantity many times, they expect that:	74	72	76	63	74	75	79	7[illegible]	30	77	72	75	74	76	72	76
51	Which one of the following is essential in an experiment?	71	72	70	57	72	72	75	69	72	75	74	76	66	73	65	--

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BUREAU OF RESEARCH, PLANNING AND EVALUATION
CONNECTICUT DEPARTMENT OF EDUCATION
FISCAL YEAR 1980-1981

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*Projected Month Available is synonymous with the month that the report is to be submitted to the State Board for review and approval.
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